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Economic and Social Council

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Commission on Science and Technology for Development
Seventeenth session
Geneva, 12–16 May 2014
Item 1 of the provisional agenda
Adoption of the agenda and other organizational matters

Provisional annotated agenda and organization of work

1. Adoption of the agenda and other organizational matters
2. Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels
3. Priority themes
   (a) Science, technology and innovation for the post-2015 development agenda
      (i) Taking stock: A decade of contributions of the Commission on Science and Technology for Development to the Millennium Development Goals
      (ii) Looking forward: Science, technology and innovation prospects for the post-2015 development agenda
   (b) Information and communications technologies for inclusive social and economic development
4. Presentation of reports on science, technology and innovation policy reviews
5. Election of the Chair and other officers for the eighteenth session of the Commission
6. Provisional agenda and documentation for the eighteenth session of the Commission
7. Adoption of the report of the Commission on its seventeenth session

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Annotations

Item 1
Adoption of the agenda and other organizational matters

1. Rule 7 of the rules of procedure of the functional commissions of the Economic and Social Council provides that commissions shall adopt, at the beginning of each session, the agenda of the session on the basis of the provisional agenda. The provisional agenda and documentation for the seventeenth session of the Commission on Science and Technology for Development were approved by the Council in its decision 2013/229 of 22 July 2013.

2. In accordance with the established practice, the Commission, at its 7th meeting on 7 June 2013, elected by acclamation the Bureau of the seventeenth session, as follows:

Chair:	Mr. Andrew Reynolds (United States of America)
Vice-Chairs:	Mr. Majed Almazyed (Saudi Arabia) Mr. Jean-Pierre Biyiti bi Essam (Cameroon) Mr. Peter Major (Hungary) Mr. Alexander Mora (Costa Rica)

3. As at previous sessions of the Commission, one of the Vice-Chairs will be designated to also serve as Rapporteur.

4. The proposed organization of work of the Commission at its seventeenth session (see annex I) is based on relevant decisions of the General Assembly and the Economic and Social Council to facilitate the consideration of agenda items within the time frame available and in accordance with the conference services allocated to the Commission. The timetable should be considered tentative and indicative; if the Commission completes its consideration of an item ahead of schedule, it may wish to proceed immediately to the next item.

5. The Commission is scheduled to meet from Monday to Friday, 12 to 16 May 2014. The morning meetings will be held from 10 a.m. to 1 p.m., and the afternoon meetings, from 3 p.m. to 6 p.m.

6. The current membership of the Commission is contained in annex II for information.

Documentation

E/CN.16/2014/1	Provisional annotated agenda and organization of work

Item 2
Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels

7. The World Summit on the Information Society (WSIS), organized by the International Telecommunication Union on behalf of the United Nations, took place in two phases: the first, in Geneva (2003), the second, in Tunis (2005). In the Geneva Declaration of Principles, the first phase of the Summit adopted a common vision and commitment to building a people-centred, inclusive and development-oriented information society.[1] The

[1] The outcome documents are available at http://www.itu.int/wsis/.

second phase endorsed the outcomes of the first phase and adopted the Tunis Commitment and the Tunis Agenda for the Information Society, which addressed, inter alia, the themes of financial mechanisms and Internet governance.

8. The Tunis Agenda for the Information Society requested the Economic and Social Council to oversee the United Nations system-wide follow-up of the outcomes of the Geneva and Tunis phases of the Summit. To this end, the Council was requested to review the mandate of the Commission, including its strengthening, taking into account the multi-stakeholder approach (Tunis Agenda, para. 105).

9. In its resolution 2006/46 of 28 July 2006 on the follow-up to the World Summit on the Information Society and review of the Commission on Science and Technology for Development, the Economic and Social Council decided that the Commission would effectively assist the Council as the focal point in the system-wide follow-up to the Summit outcomes and advise the Council thereon, including through recommendations to the Council aimed at furthering the implementation of the Summit outcomes.

10. In its resolution 2007/8 of 25 July 2007 on the flow of information for the follow-up to the World Summit on the Information Society, the Economic and Social Council requested the Secretary-General to inform the Commission annually on the implementation of the outcomes of the Summit, including all e-applications. In this connection, the Council requested United Nations organizations acting as action-line facilitators, Regional Commissions, main theme facilitators, the Global Alliance for Information and Communications Technologies and Development, and other entities, as appropriate, to submit to the secretariat of the Commission their respective reports as inputs to the annual report of the Secretary-General to the Commission.

11. The report of the Secretary-General on progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels (A/69/65–E/2014/12) aims to provide an overview of the progress made in the implementation of the Summit outcomes, highlighting examples of good and effective practices, with a view to sharing these practices and the lessons learned. It draws on the findings and recommendations of the Commission's panel discussion held in Washington, D.C., in December 2013, on inputs by United Nations bodies and specialized agencies and on other relevant literature. The Commission will review and assess progress on the implementation of the Summit outcomes at the regional and international levels, as requested by the Economic and Social Council in its resolution 2006/46.

12. In its resolution 67/195 on information and communications technologies for development, the General Assembly invited the Chair of the Commission to establish a working group on enhanced cooperation to examine the Summit mandate regarding enhanced cooperation as contained in the Tunis Agenda by seeking, compiling and reviewing inputs from all Member States and other stakeholders, and to make recommendations on how to fully implement this mandate. When convening the working group, it was also requested that the Chair take into consideration the meetings already scheduled on the calendar of the Commission, and that the working group should report to the Commission at its seventeenth session, in 2014, providing an input to the overall review of the Summit outcomes.

13. Pursuant to General Assembly resolution 67/195, the Chair of the Commission held consultations with regional and stakeholder groups, following which the final composition of the Working Group on Enhanced Cooperation was announced in March 2013. The Working Group, which consists of 22 Member States and five representatives each from the private sector, civil society, technical and academic communities, and intergovernmental and international organizations, held two meetings in 2013. It will convene at least once more in February 2014 and again, if necessary. The Working Group will report to the seventeenth session of the Commission, providing an input to the overall review of the

WSIS outcomes, based on Economic and Social Council resolution 2013/9 (see para. 15 below) and General Assembly resolution 67/195.

14. In its resolution 68/198 on information and communications technologies for development, the General Assembly expressed concern about the growing digital divide and the need to bridge it in order to harness the developmental implications of information and communications technologies. The General Assembly also decided to finalize the modalities for the overall review of the implementation of WSIS outcomes, in accordance with paragraph 111 of the Tunis Agenda, as early as possible, but no later than the end of March 2014, and invited the President of the Assembly to appoint two co-facilitators to convene open intergovernmental consultations for that purpose.

15. In its resolution 2013/9 of 22 July 2013 on the assessment of the progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society, the Economic and Social Council requested the Commission to organize a substantive discussion during its seventeenth session in 2014 on the progress made in the implementation of WSIS outcomes (para. 47). The substantive discussion will take place on Wednesday, 14 May 2014, as indicated in the proposed organization of work (annex I).

Documentation

A/69/65–E/2014/12	Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels
E/CN.16/2014/CRP.1	Report on the intersessional panel meeting

Item 3
Priority themes

16. In its resolution 68/220, the General Assembly recognized the "vital role that science, technology and innovation, including environmentally sound technologies, can play in development and in facilitating efforts to address global challenges". This includes efforts to eradicate poverty, achieve food security, enhance access to energy and increase energy efficiency, promote global health, improve education, accelerate the pace of economic diversification and transformation, and improve productivity and competitiveness, thereby supporting sustainable development.

17. In its resolution 2006/46 (para. 4), the Economic and Social Council decided that the Commission should be the focal point in the system-wide follow-up of WSIS outcomes, while at the same time maintaining its original mandate on science and technology for development. It requested that the Commission follow a multi-year work programme underpinned by a strong development orientation.

18. In accordance with this mandate, the Commission focuses in each annual cycle on a specific theme related to science, technology and innovation and a second one related to building the information society with a view to narrowing the digital divide, and examines, within its original mandate, the implications of each of these themes for development.

19. The priority themes addressed by the Commission are as follows:

(a) Science, technology and innovation for the post-2015 development agenda:

(i) Taking stock: A decade of contributions of the Commission on Science and Technology for Development to the Millennium Development Goals;

(ii) Looking forward: Science, technology and innovations prospects for the post-2015 development agenda;

(b) Information and communications technologies for inclusive social and economic development.

20. In order to contribute to a further understanding of these themes, and to assist the Commission in its deliberations at its seventeenth session, a panel meeting was convened in Washington, D.C., from 2 to 4 December 2013. The report on the panel discussion will be submitted to the Commission for consideration.

Documentation

E/CN.16/2014/2	Science, technology and innovation for the post-2015 development agenda
E/CN.16/2014/3	Information and communications technologies for inclusive social and economic development
E/CN.16/2014/CRP.1	Report on the intersessional panel meeting

Item 4
Presentation of reports on science, technology and innovation policy reviews

21. In its resolution 68/220 on science, technology and innovation for development, the General Assembly extended its appreciation to the United Nations Conference on Trade and Development (UNCTAD) for undertaking science, technology and innovation policy (STIP) reviews and encouraged UNCTAD to continue providing its expertise and analytical skills for these reviews.

22. In its resolution 2011/17, the Economic and Social Council encouraged the Commission to facilitate new STIP reviews, in close collaboration with the United Nations Educational, Scientific and Cultural Organization, the World Bank and other relevant international development banks and institutions, and to consider new modalities to monitor progress for their implementation. In particular, the Council encouraged the Commission to identify opportunities and best practices and synergies in and between e-science, e-engineering and e-education programmes worldwide in the course of performing STIP reviews. Further, the Council requested the Commission to complete and disseminate the new STIP methodology guidelines and share outcomes and best practices resulting from their implementation. Subsequently, in its draft resolution 2013/10, the Council also encouraged the Commission to enhance the treatment of information and communications technologies as an integral, empowering asset for science, technology and engineering for innovation within STIP reviews and to plan for periodic updates on progress made in countries for which STIP Reviews have been performed.

23. The Commission will hear the presentation of the report on the STIP Review of Oman, which commenced in 2013, and updates of follow-on activities from countries for which STIP Reviews were completed in the last two years.

Item 5
Election of the Chair and other officers for the eighteenth session of the Commission

24. In accordance with established practice, the Commission will elect a Chair and four Vice-Chairs for the eighteenth session at the end of the seventeenth session. One of the Vice-Chairs will also serve as Rapporteur.

Item 6
Provisional agenda and documentation for the eighteenth session of the Commission

25. In accordance with rule 9 of the rules of procedure of the functional commissions of the Economic and Social Council, the Commission will have before it the draft provisional agenda for its eighteenth session, together with an indication of the documentation to be submitted for its consideration.

Item 7
Adoption of the report of the Commission on its seventeenth session

26. In accordance with rule 37 of the rules of procedure of the functional commissions, the Commission shall submit to the Economic and Social Council a report on the work of its seventeenth session.

Annex I

Proposed organization of work

Date/time	*Agenda item/discussion topic*	*Programme*
Monday, 12 May		
10 a.m.	1. Adoption of the agenda and other organizational matters	Opening statements
		Adoption of the agenda and organization of work
	2. Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels	Introduction of the report of the Secretary-General
	Ministerial round table: Review of progress made in the implementation of WSIS outcomes	Ministerial round table followed by general debate
3 p.m.	3. Priority themes	
	Ministerial round table: Science, technology and innovation for the post-2015 development agenda	Ministerial round table followed by general debate
Tuesday, 13 May		
10 a.m.	3. Priority themes	
	(a) Science, technology and innovation for the post-2015 development agenda	Introduction and general debate
3 p.m.	3. Priority themes (continued)	
	(b) Information and communications technologies for inclusive social and economic development	Introduction and general debate
Wednesday, 14 May		
10 a.m.	2. Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels: Substantive session on the WSIS+10 Review, pursuant to paragraph 47 of E/RES/2013/9	General debate – continued

Date/time	*Agenda item/discussion topic*	*Programme*
3 p.m.	2. Continued: Progress made in the implementation of and follow-up to the outcomes of the World Summit on the Information Society at the regional and international levels: Substantive session on the WSIS+10 Review, pursuant to paragraph 47 of E/RES/2013/9	General debate – continued
Thursday, 15 May		
10 a.m.	4. Presentation of reports on science, technology and innovation policy reviews	Introduction followed by an interactive dialogue
3 p.m.	Informal consultations on draft proposals	Informal consultations on draft proposals – continued
Friday, 16 May		
10 a.m. and 3 p.m.	5. Election of the Chair and other officers for the eighteenth session of the Commission	Election of officers
	6. Provisional agenda and documentation for the eighteenth session of the Commission	Informal consultations on draft proposals continues in parallel (as required)
		Action on draft proposals
	7. Adoption of the report of the Commission on its seventeenth session	Adoption of the draft provisional agenda for the eighteenth session of the Commission
		Adoption of the draft report
	Closure of the session	

Annex II

Membership of the Commission on Science and Technology for Development at its seventeenth session

The Commission is composed of 43 members serving a four-year term.[a]

	Membership (2014)	*Term expires on 31 December 2014*
1.	Austria	2016
2.	Brazil	2016
3.	Bulgaria	2014
4.	Cameroon	2016
5.	Central African Republic	2016
6.	Chile	2016
7.	China	2014
8.	Costa Rica	2016
9.	Cuba	2014
10.	Dominican Republic	2014
11.	El Salvador	2014
12.	Finland	2016
13.	France	2014
14.	Germany	2016
15.	Hungary	2014
16.	India	2014
17.	Iran (Islamic Republic of)	2014
18.	Japan	2016
19.	Latvia	2014
20.	Lesotho	2014
21.	Liberia	2016
22.	Malta	2014
23.	Mauritius	2014

[a] There are currently two vacancies: one in the Pacific-Asia Group, and one in the Eastern European Group.

Membership (2013)	Term expires on 31 December 2014
24. Mexico	2016
25. Nigeria	2016
26. Oman	2016
27. Peru	2014
28. Philippines	2014
29. Portugal	2016
30. Russian Federation	2016
31. Rwanda	2014
32. Saudi Arabia	2014
33. Sri Lanka	2016
34. Sweden	2014
35. Switzerland	2016
36. Togo	2014
37. Tunisia	2014
38. Turkey	2014
39. United Republic of Tanzania	2014
40. United States of America	2014
41. Zambia	2016

United Nations E/CN.16/2014/2

Economic and Social Council

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Commission on Science and Technology for Development
Seventeenth session
Geneva, 12–16 May 2014
Item 3 (a) of the provisional agenda

Science, technology and innovation for the post-2015 development agenda

Report of the Secretary-General

Executive summary

This report provides an overview of how science, technology and innovation (STI) can address key challenges for the post-2015 development agenda. It addresses one of the priority themes identified by the sixteenth session of the Commission on Science and Technology for Development (CSTD): Science, technology and innovation for the post-2015 development agenda, with two subthemes: (i) Taking stock: A decade of contributions of the Commission on Science and Technology for Development to the Millennium Development Goals; (ii) Looking forward: Science, technology and innovation prospects for the post-2015 development agenda. In doing so, the report highlights the work of the CSTD during the past decade towards achieving the Millennium Development Goals (MDGs) and provides a forward-looking insight into the next set of developmental challenges and policy implications surrounding STI applications beyond 2015.

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Introduction

1. At the end of the second millennium, the international community established a set of ambitious goals to be reached by the year 2015. As that year approaches, and as the development community assesses and learns from what has and has not been accomplished under the MDGs, the issue of new goals for the post-2015 period arises.

2. The CSTD at its sixteenth session held in June 2013 selected the following as one of its priority themes for 2013–2014: Science, technology and innovation for the post-2015 development agenda, with two subthemes: (i) Taking stock: A decade of contributions of the Commission on Science and Technology for Development to the Millennium Development Goals; (ii) Looking forward: Science, technology and innovation prospects for the post-2015 development agenda.

3. To contribute to a better understanding of this priority theme and to assist the Commission in its deliberations at its seventeenth session, the CSTD secretariat convened a panel meeting in Washington, D.C., from 2 to 4 December 2013. This report is based on the findings of the panel, national briefings contributed by CSTD members and other relevant literature. The report is presented in four chapters. Chapter I examines the important role of STI for development. Chapter II summarizes the decade of work conducted by the CSTD on various themes in relation to STI and demonstrates how its work is closely linked to MDGs. Chapter III looks ahead to articulate the role of the CSTD in the post-2015 development agenda and chapter IV highlights key findings and suggestions.

I. The important role of science, technology and innovation for development

A. Poverty, inequality and the road towards sustainable development

4. There has been a growing recognition that technology and innovation have a role to play beyond industrial growth. They are important to eradicate poverty, create jobs and promote the achievement of several MDGs. Our work shows indeed that the role of technology and innovation is positive and critical at each and every stage of development. Acknowledgement of this growing role begs the question of how countries can harness the strong linkages between technology and innovation policies for overall sustainable development and welfare. This issue is a pressing concern for all countries.

5. The first challenge where STI has a critical role to play is multidimensional poverty. In addition to income, various factors comprise the deprivation experienced by the poor, including lack of education, health, housing, empowerment, employment, personal security and more. STI has a huge potential to contribute to tackling these multiple dimensions of poverty through a variety of channels. For instance, STI facilitates the creation of jobs, enhances delivery of basic public services, improves access to knowledge and education, and empowers the marginalized sections of society. However, there is need to ensure that STI efforts are directed through these channels, so that the people who are most in need are empowered in the process.

6. Inequality, the second challenge, is an indicator of whether development is inclusive.[1] During 2006–2011, income inequality has increased within most countries

[1] A Sen, 1992, *Inequality Reexamined* (Cambridge, Massachusetts, Harvard University Press).

around the world[2] and over the last two decades (1990–2010) income inequality increased by 11 per cent in developing countries.[3] To meet development challenges, policymakers need to pay attention to both horizontal and vertical inequalities.[4] Vertical inequalities are the distances between rich and poor, while horizontal inequalities are the distances between advantaged and disadvantaged culturally defined groups, such as genders, races, and religious groups.

7. Unequal distribution of income is one dimension of inequality. Differences in access to resources such as education, sanitation, water, electricity, housing, nutrition and healthcare also represent inequality, and contribute to the sense of exclusion and disempowerment. Decreasing income inequality therefore only partially addresses inclusive development. A holistic process of inclusive development would involve leadership from people in previously marginalized communities, finding ways to use their skills to earn a living, acquiring new capabilities, and contributing to economic growth. In a highly unequal society, STI is often an elite activity, serving a few people and industries. In inclusive development, STI is no longer restricted to laboratories and frontier technologies, but contributes to solving day to day challenges.[5]

8. A third challenge is making development sustainable. The primary needs of a large number of people worldwide remain largely unmet, or often met through unsustainable means. Energy systems must be transformed on a global basis to spread the advantages of electricity without excessive greenhouse gas emissions. Science and engineering have a central role to play in that redesign. Similarly, 783 million people do not have access to clean water and almost 2.5 billion do not have access to adequate sanitation.[6] These problems constitute some of the main global challenges that engineers have identified for their profession.[7]

9. The way these three challenges are addressed will be quite different in various national contexts, but in all cases they are linked to innovation processes, with critical contributions from science and technology. Targeted efforts to bring technical and local knowledge together, however, can lay the groundwork for inclusive and sustainable development, which must rest on a base of increasing educational attainment for the whole population.

B. Linking science, technology and innovation capabilities to the fundamental challenges of development

10. To understand the connections between STI, poverty, and inclusive and sustainable development, the results of STI must be understood not just as technologies but as

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[2] A Hodgson, 2012, Special report: Income inequality rising across the globe, Euromonitor International, 12 March, available at http://blog.euromonitor.com/2012/03/special-report-income-inequality-rising-across-the-globe.html, accessed 21 February 2014.

[3] United Nations Development Programme, 2014, *Humanity Divided: Confronting Inequality in Developing Countries* (New York).

[4] F Stewart, 2002, Horizontal inequalities: A neglected dimension of development, Queen Elizabeth House working paper series, University of Oxford, available at http://www3.qeh.ox.ac.uk/pdf/qehwp/qehwps81.pdf.

[5] http://www.undp.org/content/undp/en/home/ourwork/povertyreduction/focus_areas/focus_inclusive_development.html, accessed 26 February 2014.

[6] http://www.unwater.org/water-cooperation-2013/water-cooperation/facts-and-figures/en/, accessed 21 February 2014.

[7] http://www.engineeringchallenges.org/cms/8996/9142.aspx, accessed 26 February 2014.

sociotechnical systems.[8] In such a sociotechnical system, humans and technologies work together to produce outcomes to effectively respond to societal challenges.[9] For example, a transportation system is not just vehicles and roadways, but also how people drive and ride, and build and carry out maintenance. A drug designed to save lives, such as insulin, can actually kill if it is not used according to instructions, such as timing, control of dosage and equipment disposal, all of which require a certain level of education and preparation in a sociotechnical system

11. There is broad consensus that a well-functioning national STI ecosystem needs to include, inter alia, political stability and well-functioning institutions, an educated workforce, sound research and education infrastructure, linkages between public and private innovation actors, enterprises committed to research and development, and a balanced intellectual property rights framework. However, this by itself is insufficient to ensure STI for inclusive and sustainable development.

12. Applying STI to inclusive and sustainable development involves three related approaches:

(a) Addressing basic needs through innovation capacity;

(b) Promoting entrepreneurship, starting at the grassroots level;

(c) Promoting inclusive growth by building STI capabilities and absorptive capacities.

13. First, developing innovation capacity in the sociotechnical systems that meet the basic needs of people, such as food, water, sanitation, health, housing and transportation promotes the ability of countries to deliver essential public goods. All these needs have technological elements and may require complex combinations of household, community, public and private action. Local problems often act as a major stimulus to innovation, and these need to be fostered through policy incentives. Examples abound, including the cure to sickle cell anaemia in Nigeria by local researchers, or the discovery of new irrigation technologies in Asia.

14. Second, in addition to its role in providing global public goods, STI serves as a crucial driver of rising prosperity and improved national competitiveness. Promoting entrepreneurship, including grassroots entrepreneurship, is a critical engine of improving living conditions and growing incomes. Entrepreneurship is often disconnected from innovation policies, and the relevance of grassroots entrepreneurship is largely underestimated.

15. Third, building STI capabilities over time is an important prerequisite of promoting inclusive growth, but inclusiveness is not automatic. Studies on economic catch-up of several countries illustrate this clearly:[10] a strong, government-led effort that allows sociotechnical systems to flourish, local firms to be formed, survive, grow, and provide jobs is essential for inclusive catch-up, as the case of the Republic of Korea illustrates.

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[8] M Fressoli, A Smith and H Thomas, 2011, From appropriate to social technologies: Some enduring dilemmas in grassroots innovation movements for socially just futures, ninth Globelics International Conference 2011, 15–17 November, Buenos Aires.

[9] WE Bijker, TP Hughes and T Pinch, eds., 1987, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Massachusetts, MIT Press).

[10] L Kim, 1997, *Imitation to Innovation: The Dynamics of Korea's Technological Learning* (Boston, Harvard Business School Press).

II. Taking stock: A decade of work on science, technology and innovation issues by the Commission on Science and Technology for Development towards the realization of the Millennium Development Goal targets

16. Through its priority themes, the CSTD has worked on a range of STI issues that are relevant for development over the past decade and that can be grouped under five significant thematic areas. These are:

(a) STI and bridging the technological divide;

(b) STI to meet social objectives, such as sustainable urbanization, agriculture and energy;

(c) STI for capacity-building, particularly through education and research;

(d) Information and communications technologies (ICTs) and the digital divide;

(e) The impact of new technologies on development.

The priority themes under these five thematic areas contribute to various MDGs and the associated debates on how to promote the effectiveness of various interventions in the developmental process (see table).

Linking the science and technology priority themes of the Commission on Science and Technology for Development with the Millennium Development Goal targets

Priority themes	*Millennium Development Goals*
1. STI for sustainable cities and peri-urban communities	Goal 1: Eradicate extreme poverty and hunger
	Goal 7: Ensure environmental sustainability
2. Open access, virtual science libraries, geospatial analysis and other complementary ICT, STI, engineering and mathematics assets to address development issues, with particular attention to education	Goal 1: Eradicate extreme poverty and hunger
	Goal 2: Achieve universal primary education
	Goal 4: Reduce child mortality
	Goal 5: Improve maternal health
	Goal 6: Combat HIV/AIDS, malaria and other diseases
	Goal 7: Ensure environmental sustainability
3. Measuring the impact of ICTs for development	Can potentially be linked to all Goals since ICTs are critical for delivering STI applications to address challenges, including target 7.D and indicator 7.10
4. Innovation, research and technology transfer for mutual advantage,	Can potentially be linked to all Goals since building innovation capabilities are critical

entrepreneurship and collaborative development in the information society	to promote problem-solving, including addressing Goal 4 (reduce child mortality rate, particularly indicator 4.3 in relation to immunization against measles); Goal 6 (combat HIV/AIDS, malaria and other diseases); Goal 7 (ensure environmental sustainability, particularly targets 7.B, 7.C and 7.D)
5. Technology and innovation for sustainable agriculture	Goal 1: Eradicate extreme poverty and hunger Goal 3: Promote gender equality and empower women Goal 7: Ensure environmental sustainability
6. New and emerging renewable energy technologies for sustainable development	Goal 1: Eradicate extreme poverty and hunger Goal 7: Ensure environmental sustainability
7. STI and engineering and capacity-building in education and research	Goal 1: Eradicate extreme poverty and hunger Goal 2: Achieve universal primary education Goal 7: Ensure environmental sustainability
8. Promoting the building of a people-centred, development-oriented and inclusive information society, with a view to enhancing digital opportunities for all people	Goal 2: Achieve universal primary education Goal 3: Promote gender equality and empower women
9. Bridging the technological gap between and within nations	Goal 1: Eradicate extreme poverty and hunger Goal 2: Achieve universal primary education Goal 7: Ensure environmental sustainability
10. The mutual interaction and dependency of science and technology education with research and development	Goal 1: Eradicate extreme poverty and hunger Goal 2: Achieve universal primary education Goal 7: Ensure environmental sustainability

Source: Compiled by the CSTD secretariat.

A. Science, technology and innovation for the Millennium Development Goals and bridging the technological divide

17. The CSTD was one of the first forums to discuss the growing technological divide and how to promote STI to meet the MDGs. In 2004, discussions focused on "Promoting the application of science and technology to meet the development goals contained in the Millennium Declaration".[11] The following key issues were highlighted, particularly focusing on new and emerging technologies:

(a) Biotechnology can provide effective solutions for eradicating extreme poverty and hunger[12] through increased crop yields, as well as reducing child mortality[13] and improving maternal health[14] through enhancing nutritional value in foods. However, it also poses potential risks which could be counterproductive to ensuring environmental sustainability,[15] and human health.

(b) ICTs promote distance training of teachers and health workers, which aids the achievement of universal primary education.[16] It can also assist in the reduction of child mortality, improvements in maternal health and combating HIV/AIDS, malaria and other diseases.[17].

(c) Technology is not just difficult to diffuse across national borders, but also within. National income inequality amplifies the gap between the rich and the poor in terms of access and affordability of various STI services, including ICTs, resulting in a significant digital divide.[18]

18. Policy recommendations of the CSTD on this theme include the following:

(a) A need for human capital development, for an improvement of physical and services infrastructures, and for global efforts, such as international technology transfers and internationally coordinated projects;

(b) Governments should build local capabilities to target and facilitate acquisition of technology through foreign direct investment, particularly by focusing on the acquisition of information and knowledge, in addition to imports of machinery and equipment, which are by-products of international trade.

B. Science, technology and innovation to meet social objectives, such as sustainable urbanization, agriculture, and energy

19. Keen to analyse and consider STI as a means to achieve social objectives, the Commission has considered three such social objectives at length over the past decade: energy, sustainable agriculture and sustainable urbanization.

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[11] See http://unctad.org/en/Docs/ecn162004d2_en.pdf, accessed 26 February 2014.
[12] Goal 1: Eradicate extreme poverty and hunger.
[13] Goal 4: Reduce child mortality.
[14] Goal 5: Improve maternal health.
[15] Goal 7: Ensure environmental sustainability.
[16] Goal 2: Achieve universal primary education.
[17] Goal 6: Combat HIV/AIDS, malaria and other diseases.
[18] See http://unctad.org/en/Docs/ecn162006d2_en.pdf, accessed 26 February 2014.

1. New and emerging renewable energy technologies for sustainable development[19]

20. To enable diffusion and development of renewable energy technologies, the Commission identified key issues and policy considerations, including the following:

(a) The importance of access to electricity and modern energy services to, inter alia, enable higher yields in agricultural production, which can tackle extreme poverty and hunger; increase access to information and telecommunications; improve health and quality of healthcare; improve the general standard of living;

(b) The role played by access to modern energy in gender equality and education.[20]

21. Policy recommendations made by the CSTD include:

(a) On the technical front, international organizations should continue to provide support through technical assistance in training, capacity-building and strategic planning to promote new and renewable energy sources and technologies.

(b) On the financial front, large-scale resources have been committed by various international agencies to accelerate investments in technological changes, but these need to be mobilized.

(c) On the political front, it is necessary to address the unresolved issue of how to balance trade and intellectual property regimes for technology transfer, processes and production methods (for example, open-source software, Eco-Patent Commons and global technology patent pools).

2. The role of technology and innovation in sustainable agriculture[21]

22. To suggest appropriate forms of policy support, the CSTD highlighted the importance of new as well as traditional sustainable production methods and related skills and technologies of relevance for the promotion of sustainable agriculture. Key issues include the following:

(a) How can promising science and technology applications and farming practices be applied globally to increase agricultural productivity?

(b) How can agricultural innovation systems, which involve the integration of different sources of knowledge, including local knowledge, be promoted? For example, women and other marginalized groups often hold local knowledge of high-impact, low-cost methods and coping strategies that can make farming systems more resilient.

(c) How to design intellectual property rights regimes that protect farmers and expand participatory plant breeding, while fostering local control over genetic resources and related traditional knowledge to increase equity?

23. Policy considerations made by the CSTD include the following:

(a) National innovation coalitions and innovation platforms around particular technologies, policies, or processes are critical for innovation.

(b) Successful agricultural innovation requires attention to all components of agricultural systems including research, extension, credit and technical support, healthy markets, functioning infrastructure, and a supportive policy and institutional environment.

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[19] See http://unctad.org/en/Docs/ecn162010d4_en.pdf, accessed 26 February 2014.

[20] Goals 2 and 3.

[21] See http://unctad.org/en/Docs/ecn162011d2_en.pdf, accessed 26 February 2014.

(c) Harnessing the potential of intellectual property rights for the protection of farmers and the promotion of plant breeders is essential. This may also enable local control of genetic resources related to traditional knowledge, which can increase equity.

3. Science, technology and innovation for sustainable urbanization[22]

24. The Commission focused on innovative planning, technology and governance models already in use in several cities across the globe. Improvements in spatial planning and mobility can play a role in poverty eradication. Energy, waste management and buildings are sectors that can address resource depletion.[23] Increased resilience in cities is a cornerstone of adaptation to climate change. Integrating peri-urban zones into urban planning can bring benefits in terms of food security, water and employment opportunities.[24]

25. The key issues considered included the following:

(a) Addressing inadequate transportation infrastructure in cities through technologies that improve urban mobility;

(b) Innovative energy solutions that work best in crowded urban environments, such as kinetic energy-generating pavements, district heating systems, and smart electric grids;

(c) The use of integrated waste management to address urban waste, as well as waste-collection initiatives through partnerships with various actors;

(d) The role of hazard monitoring and surveillance techniques, geospatial tools for assessing disaster risk, as well as ICTs to enable cities to monitor risks in an integrated manner and contribute to natural disaster resilience.

26. A rich set of policy recommendations made by the CSTD focused on the use of low-tech and high-tech solutions to promote sustainable urban growth, such as the following:

(a) Developing spatial plans in early phases of urbanization based on political consensus of stakeholders can be beneficial.

(b) Cities can make use of technologies to convert certain types of waste into energy.

(c) The use of new technologies in cities can reduce the burden of rapidly increasing energy demand.

(d) Local governments in developing countries can address housing shortages through construction initiatives for affordable, sustainable housing and upgrading informal settlements.

(e) Peri-urban areas can benefit from social inclusion programmes that upgrade existing informal settlements and prevent the formation of new informal settlements through adequate spatial planning.

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[22] See http://unctad.org/meetings/en/SessionalDocuments/ecn162013d2_en.pdf, accessed 26 February 2014.

[23] This contributes to all targets of Goal 7.

[24] This contributes to Goals 1 and 7.

C. Science, technology and innovation, and capacity-building, particularly through education and research

27. Following the 2008 United Nations MDGs report, which indicated that indigenous technological capabilities have not yet played a very significant role, the CSTD highlighted some of the progress made in a number of MDG areas through STI, and deliberated upon issues that need further attention.[25] These include the decrease in mortality rates[26] caused by diseases such as malaria, HIV/AIDS and measles,[27] and an increase in the number of people with access to safe drinking water.[28] For some targets, as recognized by the CSTD, progress has depended upon large-scale internationally funded projects to distribute product-embedded technology directly to the user. These include, for example, the distribution of anti-retroviral, insecticide-treated bed nets, and measles vaccination programmes. An important reference was made to the time period required by many countries, especially in sub-Saharan Africa, for capacity-building in STI. In this respect, the CSTD noted that there is a need to plan beyond the 2015 MDG targets and discussed related issues as part of three main themes, as presented below.

1. Deployment of science and technology for development

28. Science and technology for development needs to begin with building indigenous capabilities and creation of absorptive capacity in countries, but is insufficient by itself to achieve technological catch-up in developing countries. Some key recommendations made under this topic were as follows:

(a) Building innovative capabilities at the national level requires efforts in three interrelated areas: enterprise development, human capital and STI policy capacity.

(b) From a national innovation system perspective, STI-related policies cross various sectoral/ministerial mandates. Building a successful innovation system will depend on creating a balance between both the prevailing national and global contexts, which are constantly changing.

(c) Prioritizing South–South cooperation in addition to existing North–South cooperation at the national level in STI policies is crucial to explore new partnerships for development.

2. Technology transfer for mutual advantage, entrepreneurship and collaborative development[29]

29. Collaborative learning is critical for information exchange processes that generate mutual advantage and entrepreneurship. It underlies collaborative development efforts that extend beyond the private sector to the education, health and environment sectors. Technologies can improve entrepreneurial opportunities, enhance the means of earning a livelihood and open opportunities for trade and development.[30] The CSTD explored opportunities for collaborative research and development and innovation as a basis for capacity-building, and found that:

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[25] See http://unctad.org/en/Docs/ecn162009d3_en.pdf, accessed 26 February 2014.
[26] Goal 4.
[27] Goal 6.
[28] Goal 7.
[29] See http://unctad.org/meetings/en/SessionalDocuments/ecn162012d2_en.pdf, accessed 26 February 2014.
[30] This contributes to Goal 1.

(a) Exploring new opportunities for technology transfer involving knowledge brokering and exchange between higher income and lower income countries are crucial;

(b) Developments in physical infrastructure have not been sufficient to deliver the benefits of the information society, particularly in low- and middle-income countries;

(c) Rapid evolution and variety of access arrangements and institutional forms that offer important opportunities for public policy and entrepreneurial involvement are needed.

3. The mutual interaction and dependence of science and technology education with research and development

30. The CSTD reflected on one of the most critical linkages in the innovation system, namely, the link between education and research and development. Educational institutions, especially those of higher learning, play a significant role in research and economic development. They provide the pool of indigenous researchers and technicians as well as the platform for conducting research and development. In addition, many universities in developing countries increasingly carry the responsibilities of improving regional or national economic performance. The following key issues were considered:

(a) How can scientists apply their knowledge and influence in other fields of specialization to address global challenges, including the MDGs, and to influence policymaking?

(b) How best to review academic reward systems, particularly within developing countries, to elevate the stature of working in science and technology for development?

31. The policy recommendations included:

(a) Building absorptive capabilities within enterprises and social-welfare-provider organizations needs to be a major goal for STI policy, as these capabilities are necessary for innovation within countries;

(b) The following shortcomings, which compound at the policy level the difficulties in balancing short-term priorities and long-term goals, need to be addressed:

(i) A lack of empirical analysis of the time needed for the process of "learning" (in organizations, and at the national level);

(ii) A lack of appropriate policy research and analysis methods to evaluate the systemic impacts of different policy options;

(c) The establishment needs to be encouraged of technology offices, technology parks and incubators, which have proven to be effective to pool the scarce resources to stimulate research commercialization and subsequent enterprise growth.

D. Information and communications technologies and the digital divide

32. The CSTD has deliberated at length upon issues relating to ICTs and development. In the past decade, the scope of ICT applications has gradually increased, covering a wide spectrum of areas including health, education, employment creation, and sustainable management of resources. Some applications are critical to promote basic needs, such as health, but many applications rely on promoting economic well-being and development at a broader level. The CSTD has highlighted the prerequisites, such as ICT literacy, that are necessary to reap the benefits of ICTs, the lack of which amplifies developmental gaps among countries.

33. The CSTD has also highlighted new challenges brought about by ICTs. First among these is the digital divide, which results in countries with poor ICT infrastructure missing out on their benefits. A second implication relates to the growing importance of ICTs for business and social-service delivery, which calls for reforms in existing institutional and regulatory frameworks. Coping with these impacts requires new, multi-stakeholder governance models and sectoral restructuring. Moreover, the rapid change in ICTs perpetuates the need for such industry restructuring, which has implications for developing countries in terms of policy, as they need support to establish the right institutional frameworks to benefit from ICTs. The last challenge brought about by ICTs is the need for the development community to recognize them as more than just infrastructure, but essential tools that enable inclusive social and economic development, as in the areas of e-health and e-education.

34. These issues were deliberated as part of several themes:

(a) Promoting the building of a people-centred, development-oriented and inclusive information society;[7]

(b) Development-oriented policies for a socioeconomically inclusive information society, including policies relating to access, infrastructure and an enabling environment;[8]

(c) Measuring the impact of ICTs for development.[9]

35. The CSTD also noted emerging positive and negative implications of the Internet. Amongst the negative impacts, it highlighted the need to promote discussions on ways to deal with Internet-based crime, including fraud and copyright infringement, child exposure to undesirable content and overuse of Internet applications and games; use of the Internet to disseminate pornographic contents; and security and privacy concerns. At the same time, the Commission lauded the positive environmental impacts of ICTs including their potential to improve energy efficiency; facilitation of dematerialization; climate change monitoring and modelling; dissemination of information; and administration of carbon-pollution reduction schemes. Negative impacts also arise from energy usage and greenhouse gas emissions due to use, manufacturing and transport of ICT products and pollution from e-waste disposal.

36. The CSTD also recommended that reaping the benefits of ICT development requires coherent national policies in developing countries that tackle existing institutional challenges and set out priorities for policy coordination, taking into account political, educational, cultural, scientific, legal and financial factors. An inclusive information society will depend on governmental intervention to correct market failures, maintain competition, attract domestic and foreign investment and enhance ICT infrastructure and applications to maximize the socioeconomic benefits of ICTs, especially for underserved communities.

37. These deliberations led to several policy recommendations in relation to enhancing digital opportunities for all, including:

(a) National capability in ICT research and development should be enhanced to achieve sustainable development of the information society.

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[7] Substantive theme selected by the CSTD for the intersessional period 2006–2008. See http://unctad.org/en/Docs/ecn162007d2_en.pdf, accessed 26 February 2014.

[8] Substantive theme selected by the CSTD for the intersessional period 2008–2009. See http://unctad.org/en/Docs/ecn162008d2_en.pdf, accessed 26 February 2014.

[9] Substantive theme selected by the CSTD for the intersessional period 2010–2011. See http://unctad.org/en/Docs/ecn162011d3_en.pdf, accessed 26 February 2014.

(b) Partnerships should be fostered between developing countries in research and development, technology transfer, manufacturing and utilization of ICT products and services, to promote capacity-building and global participation in the information society;

(c) There is an urgent need to strengthen institutions and policies in developing countries dealing with STI and in particular, ICTs.

E. The impact of new technologies on development

38. The CSTD considered the impact of newer technologies on development, emphasizing their benefits as well as cautioning about the risks of exclusion, particularly in relation to open access and geospatial technologies.[39]

39. Key issues considered by the CSTD included the role of ICTs in promoting open access and virtual science to overcome barriers to the building and dissemination of the global stock of knowledge, particularly in developing countries.[40] The CSTD concluded that geographic information systems (GIS) and geospatial analysis can enhance education: they offer novel ways to interpret the world, they can help us to do tasks more quickly, make complex problems more manageable, and use advanced methods of analysis.

40. To promote these social benefits, the CSTD recommended increasing the use of GIS in education to help develop the spatial abilities required in a range of different subjects beyond geography classes. There should be efforts to integrate GIS in policymaking more fully, building GIS capacity at all levels, supporting the development of GIS applications for education, and building networks of GIS practitioners to share knowledge and best practices.

III. Looking forward: science, technology and innovation and the post-2015 development agenda

41. The post-2015 development community has the daunting task of shaping a policy agenda for development that could be relevant for decades to come. Taking stock of the decade-long work in the CSTD on STI issues, as encapsulated under the five thematic areas, helps to articulate the role of STI policies for inclusive development[41] in a variety of important topics. While one can argue that the priority themes of the CSTD have not directly reviewed progress made under individual MDGs, the work of the CSTD has always focused on how each of the MDGs can be realized through STI. Current reviews show that lack of STI capacity has in fact hindered the attainment of several MDGs. While this underlines the critical role of STI for the accomplishment of the MDGs, it also posits valuable lessons for the post-2015 agenda. The CSTD themes and recommendations thereunder have focused on how STI policies can promote three essential, inter-related goals to contribute to inclusive and sustainable development:

(a) Promoting innovation capabilities to meet basic needs;

(b) Encouraging entrepreneurship;

(c) Fostering inclusive growth through building STI capabilities.

[39] See E/CN.16/2012/3, available at http://unctad.org/meetings/en/SessionalDocuments/ecn162012d3_en.pdf, accessed 27 February 2014.

[40] Contributes to Goal 2.

[41] See http://unctad.org/en/Docs/ecn162004d2_en.pdf, accessed 27 February 2014.

42. These results, therefore, are directly relevant to the discussions within the post-2015 development community on how STI policies can be used to achieve these three objectives. The previous MDGs exercise has struggled to find ways to embed cross-cutting themes, such as STI, that are relevant to all basic needs of humankind. It is precisely on this point that the CSTD can play a very relevant role: namely, helping to articulate the role of STI in the post-2015 agenda, particularly bearing in mind the developmental challenges of the future. A recent report of the United Nations National Intelligence Council characterizes the world today and provides possible global trajectories during the next 15 to 20 years.[37] Several key issues identified may have significant implications for the post-2015 development agenda. These issues can be summarized under two major trends with lasting global impact in the years leading up to 2030: individual empowerment, and disruptive technologies.[38] The expansion of the global middle class from 737 million in 1965 to an estimated 4.8 billion people by 2030 is expected to be largely accounted for by a shift of economic power to the East and South. This shift should be poverty reducing, leading to rising demands for sociopolitical change and individual empowerment.

43. At the same time, the second major trend forecasted is that of wider access to the so-called "lethal and disruptive technologies", which will result in a persisting sense of insecurity on the one hand, and rapid growth caused by widespread exploitation of new enabling technologies, particularly in developing countries. Rapid growth in ICT-driven innovation will increasingly result in the convergence of technologies, leading to innovation in areas such as human augmentation, the Internet of things, interconnected markets and machine communication.[39]

44. Such breakthroughs will result in technologies taking over routine tasks from humans and revolutionize individual abilities to affect societies. Hence, disruptive technologies will require adaptation in terms of employment creation in new areas and government regulation to manage possible negative impacts, without hampering the opportunities. Ways and means to address these issues in a sustainable manner will undoubtedly involve the application of science and technology.

45. The CSTD needs to bear upon the post-2015 agenda as the torchbearer of the United Nations system for STI issues, by becoming a forum for horizon scanning on future developmental challenges that STI can resolve, and by presenting venues for strategic planning and policy making on the role of STI in shaping developmental outcomes.

A. Framing science, technology and innovation as a core issue for sustainable development

46. The CSTD, as a forum where countries and experts share best practices in policy and practice, can promote a more unified treatment of STI frameworks within national contexts to promote the linkages between STI and inclusive and sustainable development. Traditionally, components of STI policies have mainly been seen as falling into four major categories:

(a) Human resource policies;

(b) Research policies;

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[37] National Intelligence Council, 2012, *Global Trends 2030: Alternative Worlds*, ISBN 978-1-929667-21-5 (Washington, D.C.), available at http://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

[38] Ibid.

[39] Ibid.

(c) Technology and innovation policies;

(d) Regulatory policies.

47. Human resource policies have aimed at ensuring an adequate supply of appropriately trained people for STI activities. Similarly, science policies have focused on supplying scientists and engineers and setting up science councils. Knowledge advancement has traditionally been concentrated in academy-type systems, and issues of creating collaborative networks for product and process development, knowledge flows and interactive learning have been neglected, which are fundamental to channelling scientific capacity into problem solving and fostering locally adapted innovations that cater to local needs.

48. Regulatory policies set the ground rules for technological use. While some are directed to new technologies (such as drug safety regulations), others are heavily science based (such as environmental regulation of industrial chemicals).

49. The past decade has seen a significant movement from technology policies to technology and innovation policies in the developing world. However, there are narrow and broad definitions of the innovation process, and innovation policies may reflect one, the other, or both. The narrow definition is enshrined in STI indicators and relates to formal research and development processes. It focuses on product, process and service innovations, measured through surveys and patents.[40] The broader definition sees innovation as a process that permeates society.[41] It encompasses process, product and organizational improvements as innovations whether or not these are technological, so long as they give business a competitive advantage.

50. Each of these domains has operated fairly independently at the national levels, despite the relevance of jointly creating STI capabilities that foster developmental outcomes. The CSTD, as the forerunning forum for discussions on STI and development, should discuss and promote ways in which each of these policies can be more closely integrated with inclusive development. STI solutions to promote active responses to the trends that will characterize the world at 2030 and beyond will depend on an approach where these policies are coordinated more closely together with clear policy incentives and milestones. Some of the ways and means are proposed in the following sections.

1. Human resource policies – ensuring sufficient numbers of scientists and engineers for a nation's needs

51. Research councils, which are the central agencies ensuring human resources for STI, need to engage in public outreach to attract students to science and engineering careers. The councils often offer fellowship support for domestic postgraduate study in science, technology, engineering and mathematics. Such fellowship support may be oriented to strategic research areas that are seen as important for national industrial or social development. Research councils also need to work closely with national education authorities in expanding education capacity, particularly for tertiary education and vocational training.

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[40] See http://www.oecd.org/innovation/inno/frascatimanualproposedstandard practiceforsurveysonresearchandexperimentaldevelopment6thedition.htm, accessed 27 February, 2014.

[41] BA Lundvall, 1988, Innovation as an interactive process: From user-producern interactions to national systems of innovation. In: *Technical Change and Economic Theory*, G Dosi et al., eds. (London, Pinter) and RR Nelson, 1993, *National Innovation Systems: A Comparative Analysis* (New York, Oxford University Press).

52. Establishing programmes to send students overseas for advanced training, with the goal of building local capacity, has been helpful in several countries. However, such programmes face the challenge of brain drain, which can be addressed through legal requirements for accepting the fellowship. Such incentives are particularly needed in least developed countries, as the figures on brain drain from Africa demonstrate.[42]

53. Research council registries of scientists and engineers with competitive grants to support curiosity-driven research have shown good results in many countries. Such grants can be used not only to build and maintain a competitive human resource base, but also to encourage collaborative projects that promote local needs-based innovation, which can even be a requirement of grants schemes. The Council for Scientific Research at the University of the Republic in Uruguay, for example, has pioneered the design of programmes that link university researchers effectively with local communities to solve problems.[43]

54. Research councils, or their partners in Government, sometimes find resources for larger research centres oriented towards industries that are relevant for local priorities of countries. Because research centres combine educational with research and outreach functions, they represent opportunities for directing the scientific culture towards inclusive and sustainable goals. Outreach can involve community innovation and support for small business development. Sustainability can be a required theme for every centre and can be built into the core of any large research effort.

2. Research policies – advancing fundamental and strategic knowledge

55. Several influences compete for attention on the research agendas of developing countries:

(a) The competitiveness agenda calls for research to be oriented to the needs of industry. This orientation may direct attention to the needs of larger, export-oriented firms rather than small farmers, as for example in research on bananas in Jamaica or coffee in Costa Rica.

(b) The international profile agenda urges researchers to publish in international journals, and for firms to survive in an international environment, with the implicit result that topics of interest outside the country may become a focus of industry and science. The pharmaceutical sector in many developing countries is a good example of this. This orientation tends to tilt research and innovation away from nationally or locally important issues.

(c) The development agenda places priority on the knowledge base for addressing issues that are impeding development, particularly basic needs areas such as health, food, energy and water.

56. Integrating developmental concerns and local priorities into innovation agendas requires the strengthening of public-sector institutions in developing countries. These are often the backbone not only for research, but also for innovation. British Commonwealth countries often have public research institutions named "Council for Scientific and Industrial Research," or a variation thereof. As their names imply, their main clientele has

[42] See http://www.universityworldnews.com/article.php?story=20131011121316706 and http://www.idrc.ca/EN/Resources/Publications/Pages/ArticleDetails.aspx?PublicationID=704, accessed 27 February 2014.

[43] S Alzugaray, L Mederos and J Sutz, forthcoming, Building bridges: Social inclusion problems as research and innovation issues, *Review of Policy Research*.

traditionally been industry. Other developing countries follow the model of "academies" that are not honorific but rather sets of public research institutions.

57. Most developing countries have public-sector institutions, but their ability to be directly responsible to public goals and to act as potential sites for implementing inclusive and sustainable research agendas needs to be fostered. The post-2015 development agenda research, therefore, could be embedded into the strategic plans and operational directions first and foremost of public research institutions. Specialized bodies such as the Institute for Water Technology in Mexico could then become more common.

3. Innovation policies – stimulating the development of new products and processes

58. Most conventional innovation policies, such as intellectual property laws, technology-transfer programmes, and tax incentives for research and development are designed with the narrow definition of innovation in mind, neglecting broader societal benefits of new ideas and businesses, as well as employment generation for all. The pathway to inclusive and sustainable development, however, requires a different set of innovation policies, including extension and public technology development, as well as incentives and support for entrepreneurship.

59. Innovation to reach low-income markets is also known as "bottom of the pyramid". Large multinational firms have a substantial opportunity to serve that market, if they are innovative enough to repackage or redesign their products appropriately.[44] Unfortunately, examples of such successes are few.

60. Where innovators are linked to top-down technology systems such as public utilities, knowledge from the bottom may not be valued. Where small innovators are part of their own local networks, however, lateral learning may occur so quickly that innovation scarcely gives an advantage. This pattern is reported in the *jua kali* sector in Tanzania, an area of the informal economy that brings hundreds of mechanics and craftspeople into the same market areas, where a new design by one informal entrepreneur is quickly adopted by others, who become the competition.[45]

61. Small and community businesses can be assisted by conventional extension services, which can provide both business and technical advice. National innovation strategies should also include strong champions and programmes for social entrepreneurship, that is, successful businesses that change social structures in positive directions. An example is Sulabh Sanitation,[46] an Indian non-governmental organization with a mission to fight social discrimination. Through its innovative toilet designs and forms of marketing, Sulabh imparted dignity to the jobs of thousands of people, as well as safe, clean toilet facilities to tens of thousands of families.

4. Regulatory policies – setting the ground rules for new technologies

62. Inclusive growth through STI consists not only of science-based regulation, but also high levels of sophistication and significant investments of time, and regulations that integrate employment creation and other public goals with industry promotion. Some technological sectors have greater employment generation potential than others, and innovation policymakers should choose a mix of sectors that generate large employment possibilities across semi-skilled, low-skilled and highly skilled workers.

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[44] CK Prahalad, 2006, *The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits* (Upper Saddle River, New Jersey, Pearson Education, Inc.)

[45] S Daniels, 2010, *Making Do: Innovation in Kenya's Informal Economy* (Analogue Digital).

[46] See http://sulabhinternational.org/, accessed 27 February 2014.

63. Sustainability values need to be woven into aspects of everyday life, such as good public transportation systems, small cars, and re-usable bags for groceries – all good examples of sociotechnical systems that embody values of a society both in terms of technologies and social practices. However, the issues debated in climate change agreements illustrate differences in viewpoints dramatically.[47] From the viewpoint of developing countries, the regulatory expectations that underpin these sociotechnical systems can appear to be threatening. Limiting greenhouse gas emissions sounds like a showstopper for growth. Likewise, prohibitions on genetically modified foods can often be perceived as maintaining trade protection. Regulatory regimes raise costs, then prices, and affect the competitive status of products from the developing world.

64. Dilemmas such as these need to be resolved from the perspective of promoting poverty reduction and development opportunities in developing countries, while being sustainable. This calls for sustainable solutions that are often innovations in themselves; innovations that do not fit with existing sociotechnical systems. Distributed power generation, for example, has the potential to preserve environments, use local skills and knowledge, and spread accessibility of electrical power more quickly and thoroughly than big dam projects.[48] It is thus both inclusive and sustainable.

B. Partners in the effort

65. Various partner institutions join the main STI policy actors in national Governments in their efforts towards inclusive and sustainable development in the post-2015 era, by identifying win–win collaborations that both build STI capacity and link STI policies to development goals. The CSTD should work with the actors described in the following paragraphs to ensure a balanced treatment of STI in the post-2015 developmental agenda.

1. Public institutions

66. Relevant public-sector agencies in developing countries include entities that are beyond the traditional realm of STI, such as health and environment ministries and a range of regulatory bodies. Since it is people that are at the centre of STI capacity, partnerships between STI policy institutions and these other institutions, including educational authorities responsible for higher education, are important.

2. Subnational and supranational policy actors

67. In the post-2015 era, development will depend more on subnational policy actors, such as cities, municipalities, states, or departments, than national ones. These actors will play a critical role in directly relating local-level STI policies to economic development, attracting new companies to the area and nurturing small firms, creating employment and distributing social resources and amenities.

68. For some countries, regional organizations that define collective interests or create shared capabilities at the regional level will be increasingly important in the post-2015 era. African countries, for example, have worked together through the New Partnership for Africa's Development, a technical body of the African Union, to develop STI strategy. Latin America has built some strong regional STI institutions, including its STI indicators network formed in 1994, which has brought together national STI agencies in capacity-

[47] See http://thediplomat.com/2013/11/the-us-and-china-play-chicken-over-climate-change/, accessed 27 February 2014.

[48] See http://unctad.org/en/docs/tir2011_en.pdf, accessed 27 February 2014.

building workshops and conferences and developed a common dataset that compares STI indicators across the continent.[49]

3. International partnerships for development

National development agencies and international non-governmental organizations

69. National STI policy agencies, particularly in least developed countries, may find partnerships in the development agencies of various developed and emerging countries and in international non-governmental organizations. The definition of goals and targets related to STI in the post-2015 agenda will be critical for the success of such partnerships.

International agencies and multilateral development banks

70. International agencies and multilateral development banks have a role to play in bringing STI to bear on inclusive and sustainable development. In general, they have moved beyond a focus on growth alone and have begun to pay attention to distribution, but a focus on STI is currently only restricted to entrepreneurship. There are valuable metrics developed within the United Nations, as published in its annual MDGs report and MDG Gap Task Force Report,[50] and elsewhere. The World Bank publishes a report on World Development Indicators[51] based on officially recognized international sources, which complements the work of the United Nations in this area. The report analyses metrics in relation to each of the eight MDGs which broaden the scope of intervention, including potential areas where STI policies can have an impact.

IV. Findings and suggestions

71. The CSTD, as the torchbearer of STI issues in the United Nations system, has focused on some of the key interfaces between STI and development. This paper has tried to summarize its deliberations and present its role while also looking ahead.

A. Findings

72. Some of the most relevant findings of the report are:

(a) The role of STI as a cross-cutting theme in the post-2015 development agenda needs to be strongly articulated if STI is to contribute to sustainable and inclusive development.

(b) There is a need for new approaches that embed STI policy as an inherent compound of sustainable development in national development plans and give it priority towards this end.

(c) Other ministries, such as health and environment, must take the lead along with STI agencies, to build sustainability into national agendas in developing countries, and a range of regulatory bodies should join the effort.

(d) Most importantly, in the developing country context, STI leaders need to work together with sectoral leaders to build strategic capabilities and give maximum support to the development process.

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[49] See http://www.ricyt.org/homeenglish, accessed 27 February 2014.

[50] See http://www.un.org/millenniumgoals/reports.shtml, accessed 27 February 2014.

[51] See http://databank.worldbank.org/data/download/WDI-2013-ebook.pdf, accessed 27 February 2014.

B. Suggestions

73. The Commission is encouraged to take the following steps:

(a) Help articulate the important role of STI in the post-2015 development agenda by acting as a forum for horizon scanning and strategic planning on ways and means to use STI to tackle future challenges;

(b) Act as a forum where practitioners and experts exchange best practices in using STI for inclusive and sustainable development and help to accumulate lessons learned and improve practice;

(c) Increase communication and cooperation among countries on STI and sustainable development; in this area, STI policymakers are often partners with other government agencies, so a particular focus might be on how to work together on sustainability goals;

(d) Actively contribute to post-2015 discussions on STI and the most effective pathways to design research and innovation policies to achieve poverty reduction.

74. Member States, especially developing countries, are invited to consider the following suggestions:

(a) Promote local innovation capabilities to meet basic needs, and bring together local and scientific knowledge for solving local problems through:

(i) Collaboration between local and national programmes in setting the conditions for indigenous innovation;

(ii) Creating strong, long-term programmes for collaboration between knowledge institutions and marginalized communities to bring together local and scientific knowledge in solving local problems.

(iii) Strengthen collaboration between education institutions to increase enrolment, and to basic skills in mathematics and science.

(b) Encourage local entrepreneurship, eliminating any roadblocks to its operation by considering the following:

(i) Promotion of grassroots innovation and facilitation of commercialization of promising inventions from communities;

(ii) Investment in talented students to enable them to continue their science, technology, engineering, and mathematics education through tertiary education and postgraduate studies, at home or abroad, and provide attractive conditions for their return from abroad;

(iii) Encouraging local innovation as much as possible instead of relying on imports in all sectors of the economy.

(c) Promote the linkages between STI and sustainable development through the following:

(i) Incorporate STI into national developmental planning;

(ii) Encourage sustainability as a general value into public planning and action, including in industry among large and small companies.

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Report of the Secretary-General

Corrigendum

Paragraph 42, fourth sentence

For A recent report of the United Nations National Intelligence Council *read* A recent report of the United States National Intelligence Council

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Information and communications technologies for inclusive social and economic development

Report of the Secretary-General

Executive summary

This report analyses the role of information and communications technologies (ICTs) in enabling inclusive social and economic development. The opening section summarizes developments in the ICT sector and ICT for development (ICT4D) since the World Summit on the Information Society (WSIS), identifying significant trends, experiences and challenges. The report then considers the implications of five emerging trends in ICTs for development, which are expected to play a major part in ICT4D during the next five years. These are: datafication, big-data analysis, cloud computing, the Internet of things, and smart systems. The report concludes with findings and suggestions in the context of the post-2015 development agenda.

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Introduction

1. The significance of ICTs for social and economic development has been recognized since rapid growth in ICTs and their markets began in the mid-1990s. In 1998, for instance, the Commission on Science and Technology for Development (CSTD) published a report titled *Knowledge Societies: Information Technology for Sustainable Development*, which examined the relationship between ICTs, economic and social development, and the potential for building innovative "knowledge societies". The concept of knowledge societies, which has also been adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO),[2] spans beyond technology, emphasizing the human development processes that transform information into knowledge and enable Governments, people and organizations to effect lasting change in economy and society.

2. The high point of intergovernmental engagement with ICT4D since 1998 was WSIS, held in 2003 and 2005. In its outcome documents,[3] both summits:

(a) Affirmed the international community's commitment to "a people-centred, inclusive and development-oriented information society";[4]

(b) Endorsed and raised awareness of ICTs' potential to facilitate economic growth and social welfare, especially in developing countries;

(c) Established targets and assessment mechanisms for deployment and exploitation of ICTs until 2015.

3. To contribute to a better understanding of the changing nature of ICT issues for inclusive development, and to assist the Commission in its deliberations at its seventeenth session, the UNCTAD secretariat convened an intersessional panel meeting in Washington, D.C., from 2 to 4 December 2013. The present report, requested by Council decision 2013/229, is based on the findings of the panel, national reports contributed by Commission members and other relevant literature. It contributes to the CSTD's work on one of its priority themes for 2013/2014, to assess the role of ICTs in inclusive social and economic development.

I. Information and communications technologies, information and communications technologies for development, and developments since the World Summit on the Information Society

4. The emergence of interest in ICT4D took place within the context of long-term international concern about the challenges facing developing countries, particularly least

[1] R Mansell and U Wehn, 1998, *Knowledge Societies: Information Technology for Sustainable Development*, (United Nations, Oxford University Press). In its *World Development Report 1998/99*, the World Bank also identified knowledge as the critical driver of economic growth and social welfare for the coming century, available at http://www.mojasdatabank.info/wdr98_overview.pdf.

[2] UNESCO, 2005, *Towards Knowledge Societies: UNESCO World Report* (Paris), available at http://unesdoc.unesco.org/images/0014/001418/141843e.pdf.

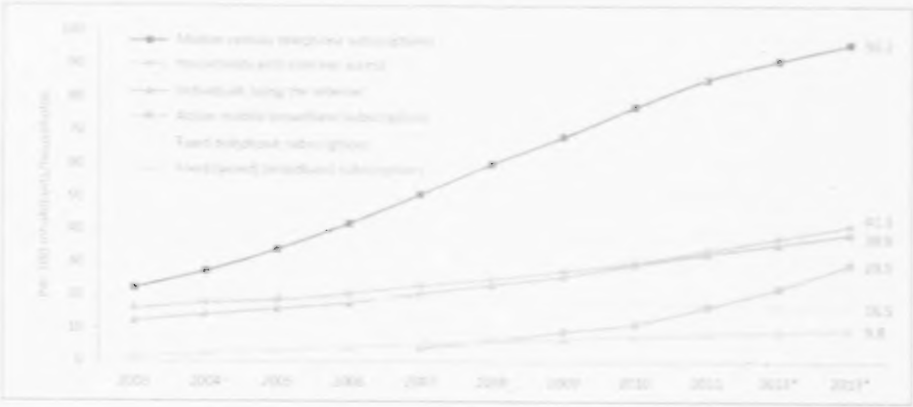
[3] WSIS, United Nations and the International Telecommunication Union, 2005, *WSIS Outcome Documents: Geneva 2003 – Tunis 2005* (International Telecommunication Union, Geneva), available at http://www.itu.int/wsis/outcome/booklet.pdf.

[4] Geneva Declaration of Principles, article 1, in ibid., p.9.

developed countries (LDCs). The United Nations Millennium Declaration of 2000 focused development activity on eight Millennium Development Goals (MDGs), concerned primarily with poverty reduction and basic needs. These have provided the framework for international development policy within which ICT4D has since evolved.

5. The growth of the ICT sector has been highly dynamic. Decades of rapid growth in capabilities of ICT components and networks, illustrated in the figure following, have driven equally rapid innovation in technology and services.

Development in global information and communications technologies access, 2003–2013



Source: International Telecommunication Union (ITU), *Measuring the Information Society, 2013*.[1]
* = estimate.

6. The rate of adoption of ICTs within societies, including developing countries, over the past two decades has exceeded that of any previous technology. The opportunities and challenges presented by ICTs, including the potential of ICT4D, are therefore also subject to rapid change.

A. The impact of information and communications technologies

7. As general-purpose technologies, ICTs value and impact arise primarily from their use in other economic and social sectors. Three ICT capabilities are especially important for economic and social development:

(a) Enabling greater efficiency in economic and social processes;

(b) Enhancing the effectiveness of cooperation between different stakeholders;

(c) Increasing the volume and range of information available to people, businesses and Governments.

8. Realization of these capabilities depends not on technology alone but on the interface between technology and other factors, particularly human capabilities needed to take advantage of them.

[1] ITU, 2013, *Measuring the Information Society 2013* (ITU, Geneva), available at http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2013/MIS2013_without_Annex_4.pdf.

9. Achieving an information society is as much about human as technological development. There are two broad, complementary perspectives on ICTs in social and economic development that can be discerned. The first perspective concerns systemic impacts of ICTs, and the second addresses impacts on policymaking.

1. Systemic impacts

10. The systemic impacts which ICTs have had on economies, societies and culture can be grouped under three areas:[6]

(a) Economic impacts, including the globalization of production, changes in international trade and distribution networks, new patterns of consumption of goods and services, the virtualization of some products and behaviours, and the ICT sector's growing importance within global and national economies;

(b) Social impacts, including mass access to greatly increased information resources, enhanced freedom of expression and association, bypassing of national regulation of markets and behaviour, new patterns of work and human settlement, changes in relationships between Governments and citizens, and challenges to traditional ideas of privacy and individuality;

(c) Environmental impacts, including higher levels of waste and carbon generation, and potential mitigation of environmental impacts from other sectors.

11. These impacts have been more profound in developed than developing countries, but are increasingly visible worldwide, posing complex challenges to policymakers. Automation and computerization reduce employment in some sectors, while increasing it in others. The enabling power of ICTs is exploited by criminals as well as legitimate businesses, and raises new challenges of data protection, surveillance and cybersecurity. The ICT sector has become the fastest growing source of physical waste and greenhouse gas emissions.[7]

2. Impacts on policymaking

12. A second set of impacts are related to the potential for Governments and other stakeholders to use ICTs in development strategies, programmes and projects. This emphasizes the active exploitation of technology as a driver to accelerate development through investment in infrastructure, stimulation of demand for ICT devices and applications, and intervention in the form of ICT4D initiatives. It is particularly evident in the work of the World Bank, ITU and the Broadband Commission for Digital Development[8] that national development strategies in countries (such as Rwanda) which

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[6] D Souter and D MacLean, 2012, Changing our understanding of sustainability: The impact of ICTs and the Internet, International Institute for Sustainable Development, available at http://www.iisd.org/pdf/2012/changing_our_understanding_of_sustainability.pdf.

[7] The rate of growth in greenhouse gas emissions from the sector is about 6 per cent per annum; see The Climate Group and Global e-Sustainability Initiative, 2008, SMART 2020: Enabling the low carbon economy in the information age, available at http://www.smart2020.org/_assets/files/02_Smart2020Report.pdf.

[8] T Kelly and CM Rossotto eds, 2012, *Broadband Strategies Handbook*, International Bank for Reconstruction and Development, International Development Association and the World Bank, available at http://broadbandtoolkit.org/Custom/Core/Documents/Broadband%20Strategies%20Handbook.pdf; Broadband Commission for Digital Development, 2011, Broadband: A platform for progress, available at http://www.broadbandcommission.org/Reports/Report_2.pdf.

explicitly focus on knowledge-led development,[9] are at the root of many programme interventions by Governments and international agencies. These range from the promotion of telecentres early in the century to the recent focus on mobile applications for health, education and enterprise development.

13. Framework ICT4D strategies and programmes have increasingly been adopted by developing-country Governments seeking to exploit the potential of ICTs to meet national priorities. Some Governments have emphasized the contribution of communications networks to economic growth by attracting investment and improving efficiency. Others have concentrated on improving administration and service delivery, through e-government and initiatives to enhance health, education and enterprise. Development agencies have emphasized the potential of ICT-enabled impacts on basic needs and MDG priorities. Experience has shown that ICT4D programmes and projects such as these can be quickly overtaken by advances in technology and market reach, and need to be flexible and adaptive to leverage maximum value.

B. The digital divide

14. The nature of the digital divide has been changing over time, both due to rapid change in technology and the highly innovative nature of new ICT applications. What are the most appropriate means of Internet access, how best to promote such access, and for what uses, are becoming key concerns. This rapidly evolving Internet landscape therefore requires a holistic perspective that considers ICTs not only as infrastructure, but as tools for economic development.

15. The changing nature of ICT access and use was recognized through five trends which emerged between 2005 and 2010. They had profound impact on ICT investment, adoption and development potential. These trends were:

(a) Progress towards universal mobile access;

(b) Transition from narrowband to broadband networks;

(c) Cloud computing;

(d) Mobile Internet and mobile applications;

(e) Social networking and user-generated content on the Internet.

16. Mobile telephone subscriptions worldwide have increased since 2005 from 2.2 billion to 6.8 billion, almost one for every person in the world.[10] Rapid growth in mobile networks and devices has also diminished gaps in basic access to the Internet, though concerns remain about affordability.

17. Two fifths of households worldwide already have Internet access. While most households in developed countries now have domestic broadband, this is rare in developing countries where mobile handsets are the most common Internet access platform. The ITU estimates that 77 per cent of individuals in developed countries now use the Internet, but only 31 per cent in developing countries and 16 per cent in sub-Saharan Africa.[11]

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[9] Rwanda's most recent plan is available at http://www.smart2020.org/_assets/files/02_Smart2020Report.pdf.

[10] See http://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2013/ITU_Key_2005-2013_ICT_data.xls.

[11] ITU statistics, available at http://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2013/ITU_Key_2005-2013_ICT_data.xls.

18. High levels of investment are being made in international, national and local broadband networks in most world regions, greatly increasing the capacity of connectivity. High-speed submarine cables are now the principal channels for international connectivity for developing as well as developed countries. Mobile broadband has been the fastest growing market segment, with developing-country subscriptions doubling between 2011 and 2013.[12]

19. These developments contribute to high rates of growth in the volume of data transmitted over networks. Cisco estimates that global Internet Protocol (IP) traffic quadrupled between 2007 and 2012, and will treble again by 2017.[13] Bandwidth usage is reported to be doubling every eighteen months.[14] Other drivers include the migration of data and applications to cloud computing and the emergence of mobile apps which facilitate data access on smartphones. The Internet of things will further drive up data volumes, raising concerns among policymakers about the adequacy of legacy infrastructure and potential spectrum shortages.

20. The growth of online social networks has become a powerful driver of Internet adoption and use in all countries, including developing countries. The most popular network, Facebook, has an estimated 1.25 billion users and is accessed by around 40 per cent of those using the Internet each day.[15] The popularity of social networks and other interactive "web 2.0" services has changed the primary Internet experience for many users from information gathering to interactivity.

21. For the last five years, concern has focused on the growing divide at higher levels of ICTs, particularly broadband, which is now seen as a crucial driver of economic growth. There is particular concern that, while middle income countries are likely to make up this difference in the short to medium term, it will be much more difficult for LDCs to do so. The gap at international level is replicated between more and less developed regions within countries, and between more prosperous and marginalized social groups.

22. The challenge of inclusiveness has been at the heart of ICT4D policymaking. Developed countries have better ICT infrastructure, enjoy more pervasive ICT usage, and gain earlier access to ICT innovations than developing countries. Urban areas and wealthier social groups in developing countries are similarly advantaged over rural areas and poorer communities. ICT access and use are less prevalent in groups that are socially or economically marginalized, such as women, youth, unqualified or subsistence workers, ethnic minorities and those with special needs or disabilities. While the value of ICTs to all is recognized, therefore, its benefits may accrue disproportionately within society.

II. Emerging trends in information and communications technologies, and information and communications technologies for development

23. Further to the five trends that significantly changed the ICT/ICT4D context between 2005 and 2010, some emerging trends that have become prominent since 2010 have the

[12] ITU, 2013, *Measuring the Information Society 2013* (ITU, Geneva), available at http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2013/MIS2013_without_Annex_4.pdf, chapter 1.

[13] Cisco, 2013, The zettabyte era – Trends and analysis, available at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/VNI_Hyperconnectivity_WP.pdf.

[14] See http://spectrum.ieee.org/telecom/wireless/edholms-law-of-bandwidth.

[15] For data on website access and usage, see www.alexa.com.

potential to drive further changes in the relationship between ICTs and development up to and beyond 2015. These are as follows:

(a) Datafication of business and government organization and practice;

(b) The emergence of big data and big-data analysis as new resources for understanding social and economic processes;

(c) Widespread adoption of cloud computing;

(d) The emergence of the Internet of things;

(e) The deployment of smart systems to improve efficiency and productivity throughout economies.

24. None of these trends are entirely new, but all have gained prominence as a result of continued rapid development in ICT technology and markets. For 50 years, the processing speed and capacity of computer processes and components has doubled approximately every two years, a trend known as "Moore's law". This has enabled a 32-fold increase in capabilities since WSIS concluded in 2005, and is ongoing. Its implications can be seen in:

(a) Increased capabilities of computing and ICT equipment, which can manipulate much larger data volumes at much greater speeds year on year;

(b) The much greater volume of data which can be usefully stored and meaningfully analysed;

(c) Increased capabilities of communications networks to transmit data between users and devices irrespective of location.

25. Altogether, these three capability improvements have had particular transformative powers, enabling new types of ICT service, driving innovation in production and consumption of other goods and services, and extending the scope and scale of data analysis and information exchange in ways that impact Governments, businesses and citizens. Those that have access to increased computational and communications capabilities have more opportunities to exploit ICTs for social and economic gain that those that do not. These emerging trends therefore open up new opportunities for social and economic development, but also pose new challenges and risks of development divides.

A. Datafication

26. The term datafication describes the process by which data become the critical resource and determinant of performance in business and government activity, not just within the ICT sector but across entire economies.

27. Most substantial businesses in developed countries, and many in developing countries, now depend on data storage and analysis to maintain performance and gain competitiveness. Datafication is spreading down supply chains, from larger, global corporations to smaller, national and local businesses. Transactional and other relationships between Governments, businesses and citizens are increasingly managed through centralized databases and conducted online. Governments believe that datafication simplifies access, reduces costs, and improves the efficiency of service delivery. E-

government initiatives to promote datafication in developing countries are supported by the World Bank and other agencies.[16]

28. These processes put information and knowledge at the heart of Government and business, and reflect many of the aspirations expressed for information and knowledge societies. Advocates believe that more information and better analysis will lead to more appropriate policymaking, more efficient deployment of resources, increased innovation, new economic and social opportunities, and empowerment of individuals (including the poor) to manage their lives and livelihoods.

29. This provides a platform for improvements in development policy and practice, but unlocking the advantages of datafication depends on more than technology. Economists have long recognized that productivity gains do not automatically arise from ICT investments.[17] Other factors are necessary to secure them, particularly organizational changes that facilitate the efficiency gains that ICT investment renders possible.[18] Those that fail to invest in changes such as management delayering, retraining and the restructuring of supply chains fail to reap the benefits. Expertise and financial resources are also critical in leveraging the potential of datafication.

30. There are other policy challenges. Automating administration leads to job losses and can make interfaces between Government, business and citizens less rather than more transparent. Computerization requires critical business functions to be transferred from human management to algorithms, an outcome many consider risky especially in areas like international finance. The concentration and exploitation of information raises concerns about data protection, privacy and the relationship between individuals, businesses and Government that are politically contentious and administratively challenging. These need to be addressed if the potential of datafication for development is to be fully realized.

B. Big data and big-data analysis

31. The term "big data" describes the accumulation and analysis of greatly increased information resources, beyond the storage and analytical capacity of earlier hardware and software resources. It is made possible by increases in both data storage capacity and the range of available data sources.

32. Big data has great commercial value. Business models of free online services such as Google and Facebook are built around data mining, which represents detailed computational analysis of information supplied by users. Large retail and other businesses likewise acquire, store and mine data on their customers. The information resources and analytical power of big data enable them to market goods and services more effectively than conventional advertizing.

33. Governments also accumulate extensive databases on citizens, businesses and organizations, through established interfaces such as national identity schemes, taxation and education, health and justice systems. These datasets enable Governments to identify priorities and target resources. They become more powerful when conjoined with one another, enabling correlations and associations to be established between different datasets.

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[16] For an example, see http://www.worldbank.org/projects/P081771/e-lanka-development?lang=en&tab=overview.

[17] See E Brynjolfsson, 1993, The productivity paradox of information technology, *Communications of the ACM*, 36(12): 66–77.

[18] Organization for Economic Cooperation and Development (OECD), 2003, *ICT and Economic Growth: Evidence from OECD Countries, Industries and Firms* (OECD publishing, Paris).

Information technology (IT) specialists are also investigating ways of gathering and incorporating tacit (unwritten) knowledge in analysis.

34. Big-data analysis has value at both macro and micro levels. Data and metadata ("data about data") can be both aggregated to discern trends relating to whole populations, or disaggregated to focus on specific geographic, social or economic groups. Data derived from multiple sources can give a more detailed picture of both individual and collective needs and behaviour.

35. However, the value of big data can only be unlocked if data gathered are accurate, reliable and up-to-date, if national statistical offices are capable of high-quality analysis, if decision-makers are prepared to engage with development needs suggested by analysis, and if financial and logistical resources are available to target resources accordingly. These requirements pose challenges to Governments. Large-scale correlations that bring together multiple datasets are complex computational and analytical tasks that require human expertise, sophisticated IT applications and reliable access to high-quality computing and communications. Many developing-country Governments are constrained by lack of analytical capacity as well as limited access to these resources. The direction of causality is often difficult to determine when assessing developmental outcomes.

36. There are also risks in overextending ICT-enabled data gathering. The combination of multiple datasets has great potential for targeting resources, but can be used to discriminate for or against particular communities rather than ensure inclusiveness. Many people are concerned about data privacy and data protection, which require legal regulation. Too much data can overwhelm the capacity of individuals or community organizations to analyse and make effective use of them. It is important for Governments and development partners to identify where big data can add most value to national development and focus resources accordingly.

37. The scale and scope of data analysis are growing rapidly. One recent development, social media analytics, applies big-data approaches to data and metadata posted on online social networks, blogs and microblogs, analysing sentiments as well as the behaviour of user groups. Social media analytics can supplement analysis of conventional data, allowing Governments to learn more about priorities and attitudes towards public services, though it must be remembered that social media users are not demographically representative. Advocates of this approach emphasize its potential for identifying incipient problems – for example, a heightened level of online references to influenza could give early warning of an epidemic. Critics are concerned that repressive Governments could use it to target political dissidents or social minorities.

38. Crowdsourcing, citizen science, and related methodologies exploit telephone and Internet access to extend the range, diversity and scope of data collection by soliciting information from the general population. This allows information to be collected from locations which might not otherwise be reached, complementing sensor and other data sources, though these methodologies face challenges of data quality and manipulation. Successful examples include collection of air, soil and water pollution data, monitoring of election participation, and mapping emergency needs following natural disasters.[19]

39. Data derived from all these sources is becoming more widely disseminated. Open data refers to the publication by Governments of information, including raw data, statistics, analysis and research materials that result from government commissions or public expenditure. The Internet is a highly effective medium for open data publication and for

[19] For examples, see the Ushahidi platforms, available at http://www.ushahidi.com/products.

analytical methodologies such as linked open data, which uses the World Wide Web to bring together data sets that would or could not otherwise be analysed together.[20]

40. Open data policies are associated with freedom of information legislation, enacted in a growing number of countries and consistent with international instruments such as principle 10 of the 1992 Rio Declaration on Environment and Development.[21] They are considered valuable in increasing transparency and accountability, encouraging wider scrutiny of public policy and procurement decisions, enabling greater public participation in policymaking, and diversifying analytical capacity.[22] Publication of data affecting local communities helps them to maximize local opportunities, monitor local officials and protect themselves against threats such as environmental hazards.

41. While legislation has been enacted in many jurisdictions, there have been implementation problems.[23] Significant expenditure is incurred in establishing and maintaining websites and preparing data for publication. Much data has great value to businesses and some question whether Governments should provide this freely, forgoing potential commercial revenue.[24]

42. Datafication and big-data analysis can enable Governments and other development actors to improve understanding and analysis of development challenges, develop better policy responses, stimulate economic activity, and target services and resources where they will have most value. Increased information availability and access can also help citizens and communities reduce vulnerability and identify opportunities to improve quality of life and livelihood. The ability to take advantage of these opportunities depends substantially, however, on the availability of statistical and analytical skills within Government, business and the wider community, and complementary resources, including literacy, educational skills and access to investment funds.

C. Cloud computing

43. Cloud computing provides important resources for datafication and big-data analysis. In this model, not only users' data but also applications are held in data centres managed by IT companies rather than users' own devices, accessed online as and when required. This resembles the client/server computing model that preceded widespread personal computing, but, rather than using in-house servers, takes advantage of the greatly increased computational and communications capacity offered by global IT and telecommunications businesses.[25]

44. Cloud computing has numerous advantages for business and government users. Instead of spending scarce resources on hardware, software and IT management, they can

[20] See, for example, http://linkeddata.org/.

[21] Available at http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163.

[22] N Rajshree and B Srivastava, 2012, Open government data for tackling corruption – a perspective; paper presented at the Association for the Advancement of Artificial Intelligence workshop on Semantic Cities, Toronto, 23 July.

[23] See https://opendata.co.ke; http://www.nation.co.ke/business/news/Open-data-initiative-has-hit-a-dead-end/-/1006/1617026/-/n18uhrz/-/index.html.

[24] See for example, R Kitchin, 2013, Four critiques of open data initiatives, available at http://www.nuim.ie/progcity/2013/11/four-critiques-of-open-data-initiatives/.

[25] UNCTAD, 2013, *Information Economy Report 2013: The Cloud Economy and Developing Countries* (United Nations publication, Geneva), available at http://unctad.org/en/PublicationsLibrary/ier2013_en.pdf.

procure these more flexibly from cloud providers, varying capacity as needed, using mobile as well as personal computer platforms. Shared access to such large resources enables clients, including Governments, to benefit from substantial economies of scale. Business savings are estimated at up to 40 per cent of IT costs, though these vary between business contexts.[26]

45. One estimate suggests the global cloud market will treble between 2010 and 2015, rising to US$43.3 billion, though estimates vary reflecting uncertainty in predicting ICT trends.[27] Although concentrated in developed countries, cloud services are spreading rapidly in emerging markets and middle-income countries. Individuals everywhere make extensive, unconscious, use of cloud-based services for electronic mail, social networking and entertainment access. Many global and developed-country businesses manage customer relations through cloud services provided by companies such as Salesforce, or use cloud-based tools offered by providers such as Amazon Web Services to manage business processes and offer information services.[28] Some developed-country Governments have now prioritized cloud procurement, to take advantage of perceived efficiency and cost savings.[29]

46. While Governments are keen to benefit from savings derived from cloud procurement, many have concerns about loss of sovereignty over data and applications if these are outsourced to global cloud providers. Large-scale data centres cost as much as US$1 billion to deploy. Economies of scope and scale result in the dominance of global cloud provision by very large IT companies. Many Governments fear they may become locked into contracts which become uncompetitive or are insufficiently interoperable, or are concerned that cloud-based data will be vulnerable to surveillance or hacking by unauthorized third parties, including other Governments. These reservations inhibit cloud adoption. Reliance on cloud-based services also depends on the quality of national communications and power infrastructures, which remain deficient in many developing countries.

47. Governments of developing countries can tap into the potential of the cloud by carefully assessing potential costs and benefits before making procurement commitments, but also by positively addressing infrastructure, legal and other constraints which currently discourage cloud provisioning.[30] Further opportunities abound for developing-country businesses. Some countries may be able to establish national data-centre markets, fulfilling the desire of Governments and businesses to retain data in-country while still accessing services from global cloud providers. The Government of Kenya, for example, has commissioned data centres to provide facilities not just for government departments but also national and regional businesses concerned about data sovereignty. There is also scope for development of cloud aggregation and brokerage services, and of innovative cloud-based applications addressing local information needs.

48. Cloud computing seems poised to spread rapidly through developing economies, with potentially profound impacts on business costs and the ability of firms to innovate. Maximizing its value depends, however, on the availability of reliable, high-quality

[26] Ibid.

[27] Cited in R Berry and M Reisman, 2012, Policy challenges of cross-border cloud computing, *Journal of International Commerce and Economics*, available at http://www.usitc.gov/journals/policy_challenges_of_cross-border_cloud_computing.pdf.

[28] Examples can be found at http://aws.amazon.com/solutions/case-studies/all/.

[29] UNCTAD, 2013, *Information Economy Report 2013: The Cloud Economy and Developing Countries* (United Nations publication, Geneva), available at http://unctad.org/en/PublicationsLibrary/ier2013_en.pdf, pp. 60 and 91.

[30] Ibid.

broadband infrastructure and steps to overcome challenges of data protection and data sovereignty.

D. The Internet of things

49. The Internet of things will extend the reach of connectivity beyond people and organizations to include objects and devices. Businesses and administrative systems already connect and monitor objects and devices through radio-frequency identification tags and global positioning systems. The Internet of things will take this further, enabling anything to which an IP address can be attached – "everything from tyres to toothbrushes"[31] – to be connected, respond to digital instructions, and gather data for analysis.

50. The Internet of things requires an increased availability of IP addresses. The Internet is migrating to a new version of the IP, IPv6, which vastly expands the number of available addresses, eliminating their shortage in IPv4. Transition has been slow, with only 3.75 per cent of websites worldwide using IPv6 in November 2013, but is expected to accelerate.[32]

51. The advocates of the Internet of things envisage it leading to "a plethora of innovative applications and services, which will enhance quality of life and reduce inequalities whilst providing new revenue opportunities for a host of enterprising businesses" including "medical diagnosis and treatment, cleaner water, improved sanitation, energy production, the export of commodities and food security".[33] Few such applications have yet emerged. However, Internet-connected sensors are now widely used to monitor weather patterns, pollution levels and traffic patterns, enhancing government capacity to intervene in short-term crises and to develop better-informed, more effective long-term policies.[34] Sensor-derived data can be published as open data, reinforcing participation in monitoring and helping individuals respond appropriately to changing circumstances.

52. In developing countries, the principal short-term impact of the Internet of things is likely to concern specific applications given overall ICT infrastructure issues. Radio-frequency identification tags and global positioning systems, for example, can facilitate monitoring of trade consignments along supply chains, or help to manage the supply of educational materials and drugs in schools and clinics. Devices attached to vehicles can gather real-time information about traffic flows, enabling better traffic management – a major challenge in large, complex urban environments with poor infrastructure. Remote sensors can play an increasingly important part in monitoring environmental hazards such as climate change, health emergencies, and social unrest, enabling more timely adaptation, not least at local levels.

53. The Internet of things could reshape the relationship between people and devices as well. Alongside these potentially beneficial outcomes, however, the arrival of the Internet of things has intensified concerns over privacy and data protection. The information generated will greatly increase individual data footprints, enabling greater scrutiny of behaviour by Governments and businesses. The balance between information availability

[31] See http://www.itu.int/osg/spu/publications/internetofthings/.

[32] See http://w3techs.com/technologies/details/ce-ipv6/all/all.

[33] ITU, 2005, *The Internet of Things*, ITU, Geneva, available at http://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-IR.IT-2005-SUM-PDF-E.pdf.

[34] The city of Porto in Portugal, for example, has seen a number of pilot studies to exploit the connectedness of vehicles and sensory devices for improving civic management. See presentation by Joao Barros on innovative ICT applications in Porto, Portugal, at the Internet Governance Forum, Bali, 22 October 2013, see http://www.intgovforum.org/.

and confidentiality is likely to be a major factor in public policy debate around the development of the Internet of things.

E. Smart systems

54. Smart systems are ICT-enabled processes that facilitate more efficient production, distribution and consumption of goods and services. Their potential has been explored in a 2008 report of the business-led Global e-Sustainability Initiative,[35] which identified four sectors in which substantial financial and carbon savings could result from ICT deployment, namely:

(a) Smart motors (automation and monitoring in manufacturing);

(b) Smart logistics (transport and storage management);

(c) Smart buildings (building design, management and automation);

(d) Smart grids (management of electricity generation and distribution).

55. Smart systems can have substantial impacts on financial and environmental costs of non-ICT infrastructure, reducing waste, stimulating development and affecting global policies on sustainability and climate change. They have particular potential in power and transport infrastructures. Improved efficiency in these sectors should lower costs, increase availability and affordability of goods and services, and reduce the environmental footprint of industrial and utility processes. Smart grids illustrate the potential.

56. The use of ICT tools in power generation and distribution can avoid excess production and reduce waste in energy supply, while improved real-time communications with end-users should improve efficiency in energy consumption. The scope for savings is greatest in developed countries, which have high levels of power usage, but smart grids are also relevant for developing countries where energy production and consumption are expected to increase substantially. The Global e-Sustainability Initiative claims that smart grids could reduce losses in power transport and distribution in India by 30 per cent, achieving substantial financial and carbon savings.[36]

57. Smart systems share some characteristics with the Internet of things. Though operating at a larger scale, and incorporating a wider range of ICT technologies and applications, they rely significantly on monitoring distributed devices such as electricity meters to gather data and maximize efficiency. However, smart systems require considerable capital investment in relevant sectors, as well as in high quality, reliable communications. As with the emerging trends discussed above, fulfilment of their potential depends on human and financial as well as technological resources.

[35] The Climate Group and Global e-Sustainability Initiative, 2008, SMART 2020: Enabling the low carbon economy in the information age, available at http://www.smart2020.org/_assets/files/02_Smart2020Report.pdf.

[36] Ibid., pp. 9 and 45–46.

III. The development potential of emerging trends

A. Emerging information and communications technology trends and the digital divide

58. The five emerging trends described in this paper illustrate the opportunities arising from ongoing advances in ICTs, and also the challenges that developing countries will experience in realizing these opportunities. These five inter-related trends can, therefore, substantially enhance the impact of ICTs on social and economic development, bringing developing countries closer to the information and knowledge societies envisaged in the 1990s and at WSIS. All five are enabled by extraordinary growth in the capabilities of computing and communications technologies which has occurred over the past decade and is ongoing. As a result, they can both improve the efficiency, coordination and cost-effectiveness of existing business and government practice, and enable business and government activities which were previously unfeasible.

59. The crucial operative word, however, is "can". Experience with ICT4D over the past decade has demonstrated the risk of focusing on the potential of ICTs in ideal circumstances without considering the contextual constraints surrounding their deployment. These include the availability, affordability and reliability of infrastructure; the quality of the legal and regulatory framework for innovation; human and institutional capabilities needed to leverage developmental value from programmes and projects; and financial resources for investment in infrastructure, human capacity and operational costs.

60. The emergence and growing importance of these five trends illustrates the pace of change in ICTs and ICT4D. They represent a stage in the ongoing development of technology and markets. Further waves of innovation, including new interfaces between people and devices, such as Google Glass, speech-based computing and automated translation suggest directions in which consumer technology and applications may evolve in the near future. The World Wide Web Consortium advocates development of the "semantic web", which would enable automated agents to perform online tasks without users' direct intervention. Research into self-regulating algorithms, artificial intelligence and organic computing also suggests trajectories for the next generation of innovation.

61. The adoption and use of ICTs have already had systemic impacts in many areas of human activity: in patterns of economic production, distribution and consumption; access to information and knowledge; the dynamics of relationships between Governments, businesses and citizens; and patterns of work, leisure and human settlement. Alongside these systemic impacts, Government and donors have sought to leverage positive outcomes from ICTs in critical areas of social and economic development, particularly health, education and enterprise development. National ICT4D strategies and programmes have contributed substantially to economic and social development since WSIS, facilitating economic growth and supporting the achievement of basic needs identified in MDGs.

62. While ICTs' impact has been greatest in developed countries, it has been substantial also in developing countries, including LDCs. Trends towards mobility, broadband and web 2.0 have contributed greatly to this outcome. The rapid spread of mobile phones, in particular, has brought information and communications opportunities that were previously confined to high-income groups and urban areas to low-income communities and rural districts. Governments have sought to accelerate their impact by stimulating infrastructure deployment through universal access programmes and, in some cases, direct investment. However, while this has enhanced inclusiveness in access and opportunity, significant digital divides remain between and within countries, particularly where broadband is concerned.

63. Although most developing regions are seeing significant investment, broadband access remains limited in many developing countries. This causes particular concern as broadband networks are essential for developing countries to make full use of more sophisticated ICT services and applications, including those discussed in this paper. These require reliable, high-quality broadband networks capable of consistently transmitting large data volumes at low prices, nationally and internationally. Reliability in this context includes redundancy (alternate routings in the event of network failure) and adequate power supplies to maintain operating levels.

64. Given that ICTs impact on all development sectors, digital divides are liable to exacerbate gaps in development outcomes between more and less well-provisioned countries, between regions within countries, and between different social groups. The high dependency of cloud computing and smart systems on broadband infrastructure means their positive impacts are likely to be felt more intensively in developed than developing countries, in middle-income countries than in LDCs, and in urban than in rural areas. A growing broadband digital divide could therefore exacerbate other development divides.

65. Not all economic sectors are equally affected by ICTs. Many LDCs are generally more dependent on raw material extraction and agriculture, and less on manufacturing and services. These sectors are less susceptible to ICTs. Substantial gains can also still arise in LDCs from wider deployment and application of basic ICTs. While these factors may mitigate the impact of later broadband deployment in lower-income countries, they do not obviate the importance of broadband investment for unlocking benefits from the emerging trends discussed above, not least for economic diversification and social welfare.

66. It should be noted, too, that digital divides are sustained by the rapid pace of innovation in ICT technology and markets. New infrastructure will always be deployed first where it is most likely to secure rapid return on investment. New services will always be bought first by those that can most readily afford them. It is important for policymakers to focus not only on absolute levels of access to ICT resources, but also on access trends. Developing countries which exhibit strong positive growth in ICT capabilities are better placed to take advantage of ICTs, including emerging trends, than those lacking a positive growth trajectory.

B. Public policy requirements for maximizing the value of emerging trends

67. Two conclusions concerning government policy can be drawn from this discussion of emerging trends.

68. Firstly, Governments should take a holistic approach to the relationship between ICTs and development. ICT impacts do not occur in isolation, but in a context of wider change, including shifts in economic power between and within countries, advances in other areas of science and technology such as agricultural production, continued population growth, and threats posed by climate change, pollution and depleted natural resources. Geographic and demographic inequalities, gender inclusiveness and political stability/instability also play important parts in determining the likely impact of ICTs and scope for policy intervention. Governments should acknowledge the increased and increasing importance of ICTs and recognize that their impact is integral to the complex dynamics of political, economic, social and environmental changes that are occurring in national economies and societies. Inclusive policies for ICT4D need to address issues of affordability, accessibility, appropriate content, and education if they are to ensure that ICTs help to reduce inequalities and enhance social and economic inclusiveness.

69. Secondly, Governments should pay attention to the enabling economic and infrastructural environment for ICTs and ICT4D. Infrastructural investment is crucial to

developing countries' capacity to engage successfully with these emerging trends. Most investment will come from the private sector. However, the scale of investment needed in broadband upgrading is very substantial. Private businesses focus on countries and districts from which high short-term returns can be expected. There is a renewed trend towards infrastructure investment by developing-country Governments, backed by international financial institutions and or equipment/network vendors. The World Bank, for example, has supported the development of a regional backbone network for the under-resourced and under-connected Central African region.[37] Such investment should continue where needed to stimulate inclusive social and economic outcomes.

70. Network access also needs to be affordable. Networks and services in developing countries typically cost more than those in developed countries, inhibiting adoption of bandwidth-dependent innovations such as cloud computing. Developing countries also typically experience less competition in broadband provision. In this context, establishing regulatory institutions that guarantee economic competition and encourage universal coverage, convergence, quality and access, is vital. Regulatory mechanisms such as open access to backbone infrastructure, infrastructure-sharing and cost-based interconnection can also play important parts in enhancing competition and reducing prices.

71. Reliability is also crucial. Sufficient redundancy needs to be built into networks to maintain connectivity when infrastructure fails. Low latency – the time delay between parties to a connection – is important in maximizing the cost-effectiveness of connectivity for cloud computing and can be improved by the deployment of country-level Internet exchange points.

72. Experience in developed and developing countries shows that appropriate legal and regulatory environments are needed for Governments and businesses to take advantage of emerging trends.

73. Legislation and regulation are needed to enable digital transactions and exchanges. Although international models are available,[38] these are still not enacted in many developing countries, inhibiting the spread of electronic commerce. Banking and business cultures must also adapt to take advantage of digital transactions and services.

74. A positive enabling environment is needed for business development and innovation. Many developing countries rank poorly in the World Bank Doing Business index which measures business regulation.[39] Governments should reduce constraints on business innovation where this will encourage adoption of ICT-enabled opportunities.

75. Legislation concerning data protection, data sovereignty and cybersecurity is also crucial. Data subjects need confidence that data will be used for their benefit, and are not susceptible to hacking and criminal activity. Governments have important concerns about data sovereignty, international surveillance, and the risk of cyberattacks.

76. Open standards play an important part in encouraging innovation, and facilitating interoperability between hardware, software and business systems. Effective data

[37] See the Central African Backbone Program Project, available at http://www.worldbank.org/projects/P108308/central-african-backbone-apl1a?lang=en&tab=overview.

[38] For example, the United Nations Commission on International Trade Law, 1996, Model Law on Electronic Commerce, available at http://www.uncitral.org/uncitral/en/uncitral_texts/electronic_commerce/1996Model.html; and UNCTAD, 2013, *Review of E-commerce Legislation Harmonization in the Association of Southeast Asian Nations* (United Nations publication, Geneva), available at http://unctad.org/en/PublicationsLibrary/dtlstict2013d1_en.pdf.

[39] See http://www.doingbusiness.org/rankings.

communications rely on interoperability between systems used by different Governments and businesses, both nationally and internationally.

77. Above all, experience suggests that Governments need a thorough understanding of their national communications and development environments when designing policies and programmes for ICT4D. International experience can be valuable, but must be treated cautiously. Later adopters of new technology can learn from the experience of early adopters, both positive and negative, but policies and programmes need to be tailored to national circumstances and needs, which may differ considerably from those of other countries. Particular attention should be paid to constraints affecting the deployment of ICTs, including limited infrastructure, power, and financial and human resources. Just as important is the pace of change in ICT technology and services.

IV. Information and communications technologies and the post-2015 development agenda

78. The next two years will be a crucial period for international cooperation on social and economic development and ICT4D. In 2015, the United Nations General Assembly will review development performance against the MDGs which, since 2000, have focused global policy on poverty reduction and social welfare.[40] The Assembly will adopt a new post-2015 development agenda, drawing on this review, evidence from sources including the Secretary-General's High-level Panel of Eminent Persons on the Post-2015 Development Agenda,[41] and input from other United Nations processes, particularly the Rio+20 Earth Summit. Work is already underway to design the Sustainable Development Goals, which will form a central part of this agenda.[42] The General Assembly will also review implementation of WSIS outcomes and the relationship between ICTs and other development sectors.

79. A ten-year review of WSIS outcomes will take place within this context. The first WSIS+10 event was organized by UNESCO in February 2013.[43] A high-level event organized by ITU is scheduled for 2014,[44] while a statistical assessment of WSIS outcomes will be published by the Partnership on Measuring ICT for Development. Further review arrangements will be made by the General Assembly.

80. The confluence of these reviews provides an opportunity for the role and significance of ICTs in social and economic development, including the contribution of emerging trends discussed in this paper, to be incorporated more systematically within the global development agenda.

81. International agencies concerned with technology and development have placed considerable emphasis since WSIS on the growing significance of ICTs and their potential to enhance development, including the MDGs.

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[40] See http://www.un.org/millenniumgoals/.

[41] *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development*, report of the High-level Panel of Eminent Persons on the Post-2015 Development Agenda (United Nations publication, New York), available at http://www.un.org/sg/management/pdf/HLP_P2015_Report.pdf.

[42] See http://sustainabledevelopment.un.org/index.php?menu=1300; and see work of the United Nations Sustainable Development Solutions Network at http://unsdsn.org/.

[43] Towards Knowledge Societies for Peace and Sustainable Development – First WSIS+10 Review Meeting; documentation available at http://www.unesco.org/new/en/communication-and-information/flagship-project-activities/unesco-and-wsis/wsis-10-review-meeting/.

[44] See http://www.itu.int/wsis/implementation/2014/forum/.

82. Many Governments and international agencies have gained significant experience in designing and implementing strategies, programmes and projects that exploit the potential of ICTs for inclusive social and economic development. Their experience, positive and negative, will form a crucial part of the WSIS+10 review. It provides a sound basis for the realistic and systematic integration of ICTs within the post-2015 development agenda, recognizing both opportunities and challenges associated with ICTs and their growing impact on economy, society and culture.

83. However, the understanding of this potential, and of the underlying systemic changes in economy and society resulting from an emerging information society, is not yet pervasive in development discourse. While recognizing that these are at an early stage, they have not featured prominently in discussions towards the post-2015 development agenda. More dialogue is needed between ICT/ICT4D and other development domains to deepen and strengthen understanding of the contribution that ICTs can make to sustainable development and the potentialities for inclusive social and economic development of emerging knowledge societies.

V. Findings and suggestions

A. Findings

84. The findings of this Report are summarized as follows:

(a) The digital divide is changing its nature, from ICT access to how ICTs can be used to promote development outcomes. The constant emergence of new applications are creating a rift between those who have the ability to benefit from them, and those who are excluded. Many developing countries, especially LDCs, risk being further impacted by the digital divide.

(b) The success of deploying ICTs in countries depends on following an ecosystem approach that engages all stakeholders and ensures comprehensive and coordinated incorporation of all inter-related elements: supply and demand, infrastructure, access, services, policy and regulation, applications, content, capacity-building, digital literacy, funding sources and mechanisms.

(c) Although ICTs provide huge benefits to human welfare, only part of their potential has been realized, and spaces of exclusion remain.

(d) ICTs need to be considered innovatively in terms of technology, business and regulation. A mindset of abundance, and not of scarcity, should be adopted, with the intention of creating more than what is currently available.

(e) There is unevenness in the production and dissemination of information on the Internet, which is not necessarily linked to lack of Internet penetration. Existing zones of exclusion in the world, for example in education, as well as existing stereotypes, are being amplified on the Internet.

(f) Affordability and the sustainability of financing for ICT projects persist as key issues.

(g) ICTs provide new solutions and opportunities for inclusion of segments of society such as people with special needs and the elderly.

(h) ICTs play an important role in enhancing the transparency and accountability of Governments and businesses.

(i) ICTs such as social media and crowdsourcing provide new possibilities for location-enabled services to citizens, especially in the context of natural disasters, as well as conflict management.

B. Suggestions

85. The CSTD is encouraged to take the following steps:

(a) The Commission should play an active role in creating awareness on the potential contribution of ICTs to the post-2015 development agenda through substantive inputs to relevant processes and bodies of the United Nations.

(b) The Commission should continue to share findings and best practices on ICTs among member States and beyond.

86. Member States, especially developing countries, are encouraged to consider the following suggestions:

(a) Systematic research on new ICT trends and their impact on development can facilitate a more nuanced understanding of the opportunities and risks they pose, particularly in the post-2015 development agenda.

(b) ICTs should be promoted through a capability-based approach rather than a needs-based approach that rests on the foundations of learning, innovation and competence-building systems.

(c) Member States should seek international cooperation opportunities in ICTs, particularly in terms of identifying best practices on e-education, e-government, e-health and disaster resilience through existing and new cooperation platforms.

(d) Member States should seek to create autonomous ICT institutions, based on sound institutional frameworks that guarantee economic competition and content plurality, and encourage universal coverage, convergence, quality and access.

(e) The gender gap in ICTs, which is particularly prevalent in Africa and South Asia,[45] should be addressed by creative, demand-stimulating regulation that popularizes ICTs and encourages the participation of women.

87. The international community should consider the following:

(a) The importance of ICTs and their impact on social and economic change will continue to grow. Therefore, the potential of ICTs for enabling sustainable development, addressing the needs of development goals, and building knowledge societies should be articulated and included in the post-2015 development agenda.

(b) There is a need to continuously measure global progress in terms of ICT adoption through data collection and the development of indexes that measure a broad array of data points. The ability to develop the right policy responses largely depends on identifying gaps and establishing targets based on such data.

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[45] See http://www.intel.com/content/dam/www/public/us/en/documents/pdf/women-and-the-web.pdf.